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MECHANIZATION

VICKERS-ARMSTRONGS
LIMITED

THE VICKERS GROUP

WAR MATERIAL

THE Vickers Group of companies is the only organization in the world which is able to furnish a modern Army with every fighting and transport requirement.

The Group can supply the following war material; all is of the most up-to-date type and represents the fruit of long and patient research:—

FOR USE ON LAND.

Rifles, including the Pedersen Semi-Automatic.

Automatic Guns of all calibres and all natures.

Ordnance of all calibres and all natures, on Field, Siege, Railway, and Anti-Aircraft Mountings.

Anti-Aircraft Fire Control Gear.

Special **Sighting Gears,** including **Anti-Aircraft Sights.**

Armoured Fighting Vehicles of all sizes, including Tanks and Armoured Cars, and Wireless Equipment therefor.

Tractors and **Transport Vehicles,** both on Tracks and Wheels.

FOR USE IN THE AIR.

Land and Marine Aircraft, for both fighting and transport purposes, and all their accessories.

Amphibian Flying Boats and all their accessories.

Bombs and **Bomb Apparatus.**

Aircraft Automatic Guns of all calibres and Mountings for them.

Parachutes and **Parachute** equipment.

Aircraft Torpedoes.

Depth Charges.

Aircraft Cameras.

"Gun" Cameras.

Airmen's Equipment.

Ammunition and **Fuzes** of all natures.

Optical Instruments.

Pyrotechnics.

FOR USE ON THE SEA.

Should an army be required to operate overseas, complete reliance may be placed upon the great and world-wide reputation of the Vickers Group to furnish all natures of fighting craft, both surface and submarine, and all transport ships for the purpose.

SPECIAL ARRANGEMENTS.

In the event of a Government deciding to place orders for the whole of their military and air requirements with the Vickers Group, special terms of a favourable nature will be offered to them.

MECHANIZATION

"Mechanization has come to stay.
It is the basis upon which the
armies of the future must organize."

VICKERS-ARMSTRONGS LIMITED
LONDON

CONTENTS

CONTENTS—*Continued.*

MECHANIZATION

The Scope of the Activities of Vickers-Armstrongs Limited.

IT is no exaggeration to say that at the end of 1918 the British Army led the way among the Armies of the world in the progress achieved in the mechanization of fighting troops, and in the motorization of their transport services. In this achievement Vickers-Armstrongs Ltd. had played an important part, having been, to some extent, responsible for the design, and to a greater extent for the manufacture of many of the early tanks produced for use on the Western Front.

Since the War, the fullest advantage has been taken of the experience gained during its course. Directed by designers of the highest accomplishments, and backed by manufacturing resources of the first order, a policy of continuous and progressive design and experiment has been followed. The great improvements realised in tracks and track suspension, and the consequent enormous increase in the general reliability of the vehicles built by Vickers-Armstrongs, enable the firm to offer a complete range of mechanically-propelled vehicles to meet both fighting and transport requirements.

Armoured Fighting Vehicles (Tanks and Armoured Cars).

Besides supplying to the order of the British War Office several different models of heavy, medium, and light tanks, and large numbers of armoured machine gun carriers (Carden-Loyds), Vickers-Armstrongs have regularly delivered both to British Government Departments and to Foreign Governments, armoured motor cars of all sizes on both 4-wheeled and 6-wheeled chassis. These cars, which have proved their suitability for employment in South America, Persia, India, Iraq, and other countries, are of the very latest design and finest workmanship.

Tractors and Lorries.

In addition to the above, Vickers-Armstrongs manufacture the most efficient types of heavy and light tractors, suitable for cross-country transport of all natures. They are also able to offer 6-wheeled lorries of the most recent designs, which have been specially built to fulfil military requirements in the varying conditions of service met with in different parts of the world.

The object of this Booklet is to give a general idea of the different vehicles for which Vickers-Armstrongs are now in a position to quote firm prices and delivery dates, and of their various uses.

Vickers-Armstrongs and Carden-Loyd vehicles are covered by patents in all the principal countries of the world.

Vickers-Armstrongs-Straussler Pontoon Equipment

Special attention must be drawn to the latest form of collapsible pontoons for military bridges. A bridging train consisting of 2 trailers mounted on Carden-Loyd special suspension and pulled by a Carden-Loyd Light Tractor has been designed, which, for a total load of 4,700 kgs. enables a stream 25.6m. wide to be crossed by rolling loads up to 6 tons in weight.

This equipment is dealt with in Section VII.

To attempt to indicate the very wide commercial application of many of the vehicles produced by Vickers-Armstrongs would demand greater space than is available in this pamphlet, but in order to give an indication of the opinions held of the high degree of mechanical excellence and tactical efficiency of the armoured vehicles and tanks built by the firm, we have included in the form of an Appendix (Appendix A), some extracts of articles written during the last three years by the widely-read Military Correspondent of the *Daily Telegraph*, Captain Liddell-Hart and by other well-known writers on Military subjects. This Appendix is to be found on pages 73-79.

In Appendix B, on page 80, will be found an extract from an article by an officer of the United States Army, which appeared in the *British Royal Tank Corps Journal* for December, 1929.

Appendix C, on page 81, is a newspaper report from Washington, dated 7th January, 1930, giving the opinion of Major-General Clarence Williams, until recently the Chief of the Army Ordnance Department of the United States Army, as to Tank Development in Great Britain.

Detailed information concerning each of the vehicles mentioned herein is contained in pamphlets, description and lithographs, which can be obtained on application to

VICKERS HOUSE,
BROADWAY, WESTMINSTER,
LONDON, S.W. 1.

SECTION I

FIGHTING VEHICLES

1. Light Armoured Vehicles
2. Tanks
3. Armoured Cars
4. Self-propelled Gun Mountings

Vickers-Armstrongs and Carden-Loyd vehicles are covered by patents in all the principal countries of the world.

1. LIGHT ARMOURED VEHICLES

(a) The Carden-Loyd

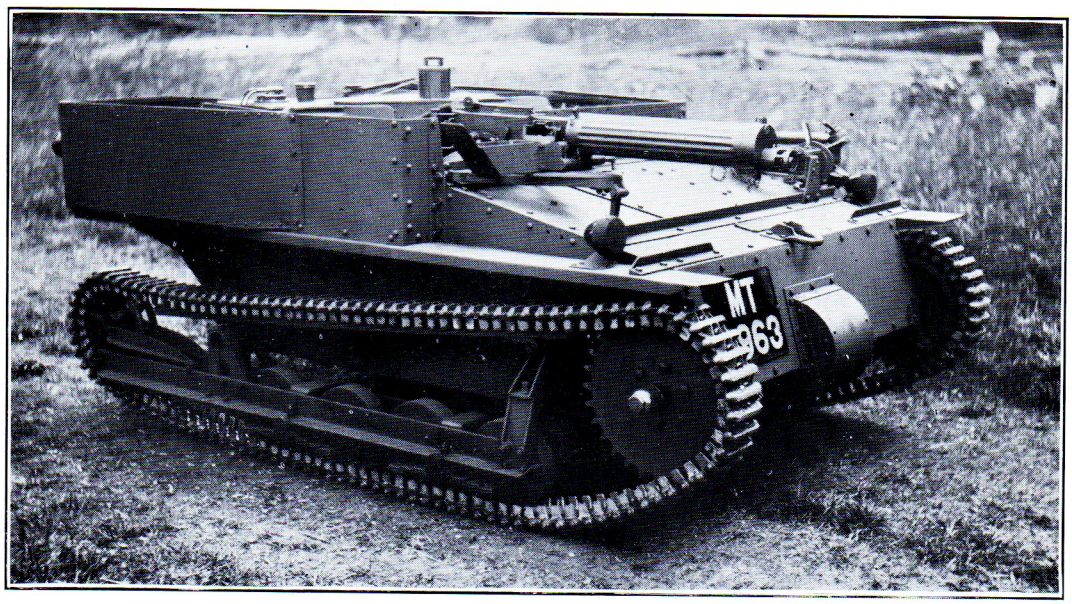

Plate I

This is the Standard Armoured Machine Gun Carrier of the British Army.

It is small, fast, and powerful. **It defeats the bullet, because it can move rapidly in any direction with immunity to Rifle Fire.**

It is so low, only 1.01 ms. overall, that it can take advantage of any available cover, while its speed and manœuvrability make it a very difficult target.

For further particulars, see Appendices A and B and the Carden-Loyd pamphlet.

LIGHT ARMOURED VEHICLES

DETAILS—Carden-Loyd

Crew . . . 2 Men.
Armament . 1 Rifle Calibre (or 12.7 mm.) Vickers Machine Gun.
Ammunition. 3,500 rounds of Rifle Calibre, or 500 rounds of 12.7 mm.
Weight of Vehicle, excluding armament—1,535 kgs.
Approximate Maximum Speed on good, level Road—40 kms. p.h.
Vehicle can cross a Trench—1.22 ms. wide.
Turning Space—3.95 metres.
Capacity of Petrol Tank—31.8 litres.

Maximum Dimensions:—

Length	2.46 ms.
Width	1.70 ms.
Height (without armoured head cover)	1.01 ms.
Height with armoured top . .	1.295 ms.

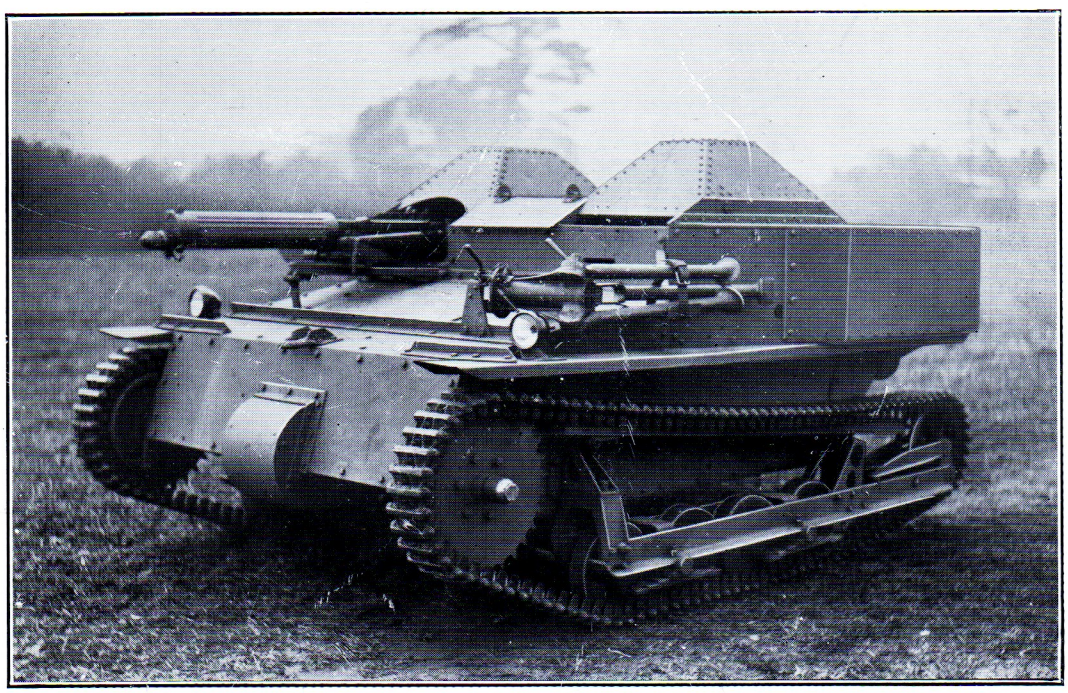

Plate II

This shows the same vehicle provided with armoured head cover.

The three armoured flaps can be opened and shut from inside the vehicle.

The above vehicle has been supplied to most of the principal armies throughout the world.

In addition to its uses as a fighting vehicle, the Carden-Loyd is invaluable as a training machine. All armies to-day have either commenced to mechanise or have appreciated the necessity for mechanization. With the Carden-Loyd, soldiers can be taught quickly and economically to handle and drive tracked vehicles. By their use, it will thus be possible in peace time to form a large trained cadre of tank and tractor drivers, who will be immediately available on mobilisation.

LIGHT ARMOURED VEHICLES

(b) The Carden-Loyd carrying a 47 mm. Gun

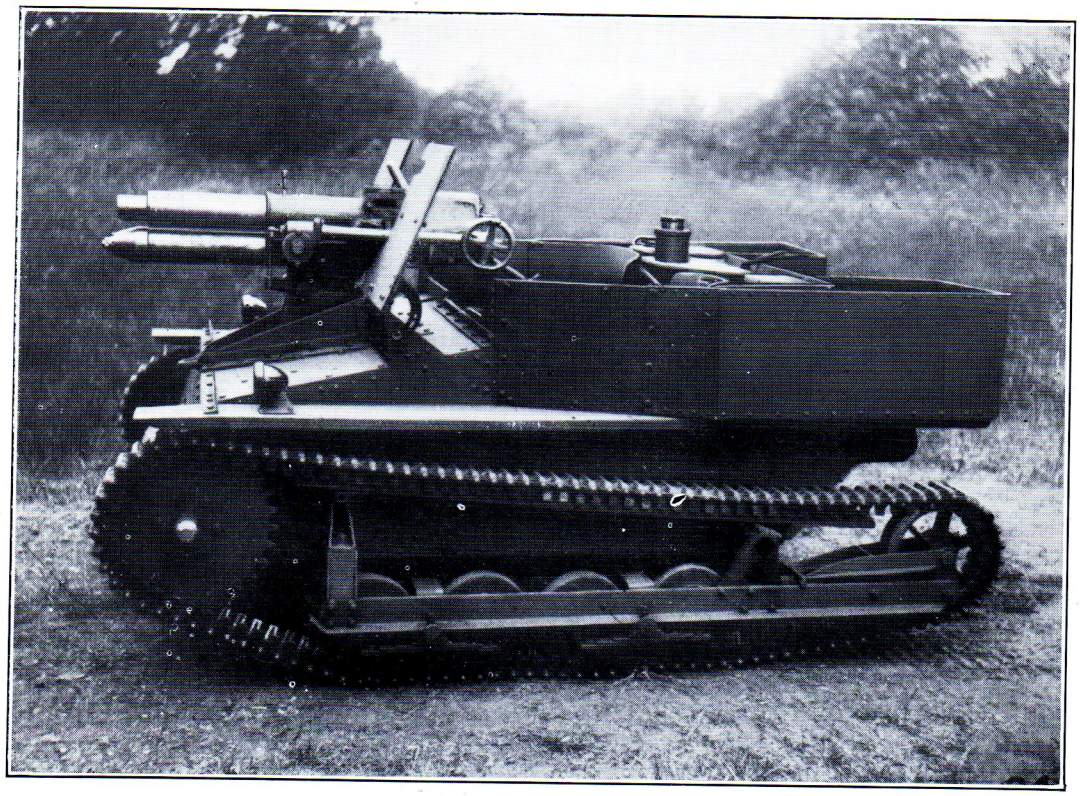

Plate III

Carrying an Infantry Gun of this calibre, the Carden-Loyd can deal with targets against which a machine gun would be useless, such as houses, shelters, etc.

The mounting shown in the illustration can be arranged to give a maximum elevation of 15°, a maximum depression of 5°, and a lateral field fire of 20°, *i.e.*, 10° each side of the centre line.

This mounting is a special one, and can be modified to take other guns of approximately the size shown. For such a gun the vehicle provides an efficient platform.

LIGHT ARMOURED VEHICLES

The details of the 47 mm. Infantry Gun are as follows :—

Weight of projectile	.	1.5 kgs.
Nature of projectile	.	Armour Piercing Shell or High Explosive
Muzzle velocity	. .	A.P. Shell 488 m. s. H.E. Shell 302 m. s.
Range at 15° elevation	.	A.P. 4,700 metres. H.E. 3,000 metres.

No. of rounds which can be carried in the Vehicle—100.

LIGHT ARMOURED VEHICLES

(c) The Carden-Loyd carrying an Infantry Mortar, complete with Bipod, Base Plate and 72 rounds of ammunition

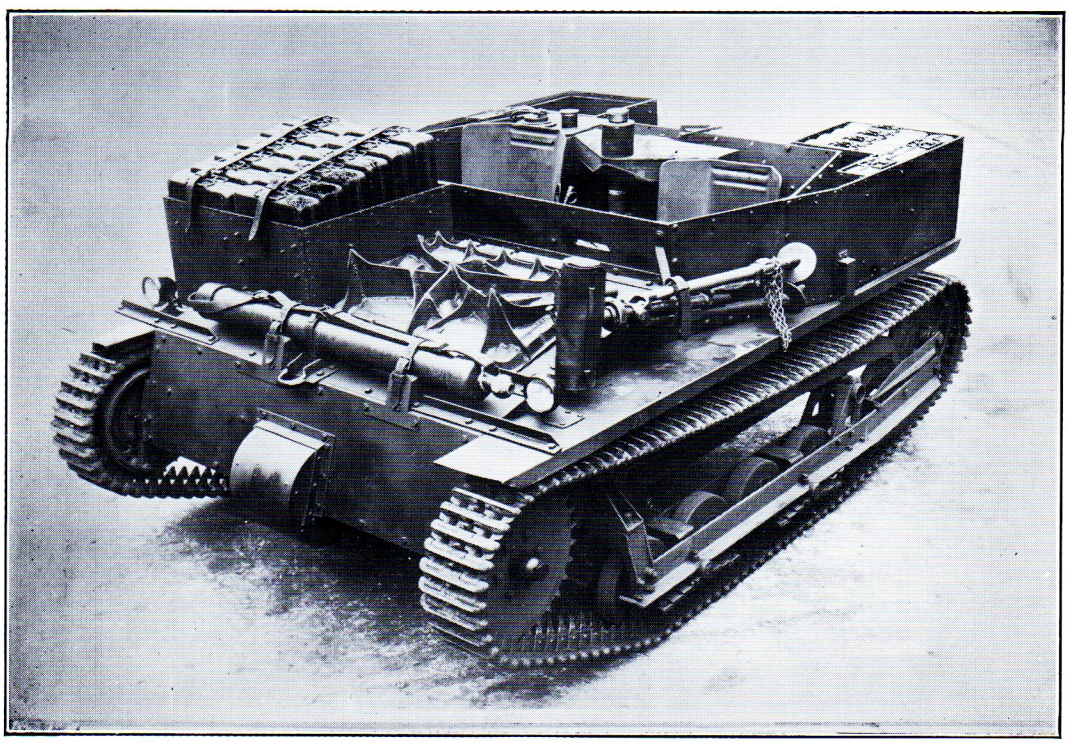

Plate IV

This shows another method of utilizing the Carden-Loyd, for the transport of an infantry mortar and 72 rounds of ammunition.

The Carden-Loyd utilized in this manner, carries another man, as well as the driver.

2. TANKS

(a) The Vickers-Armstrongs 6-ton Tank

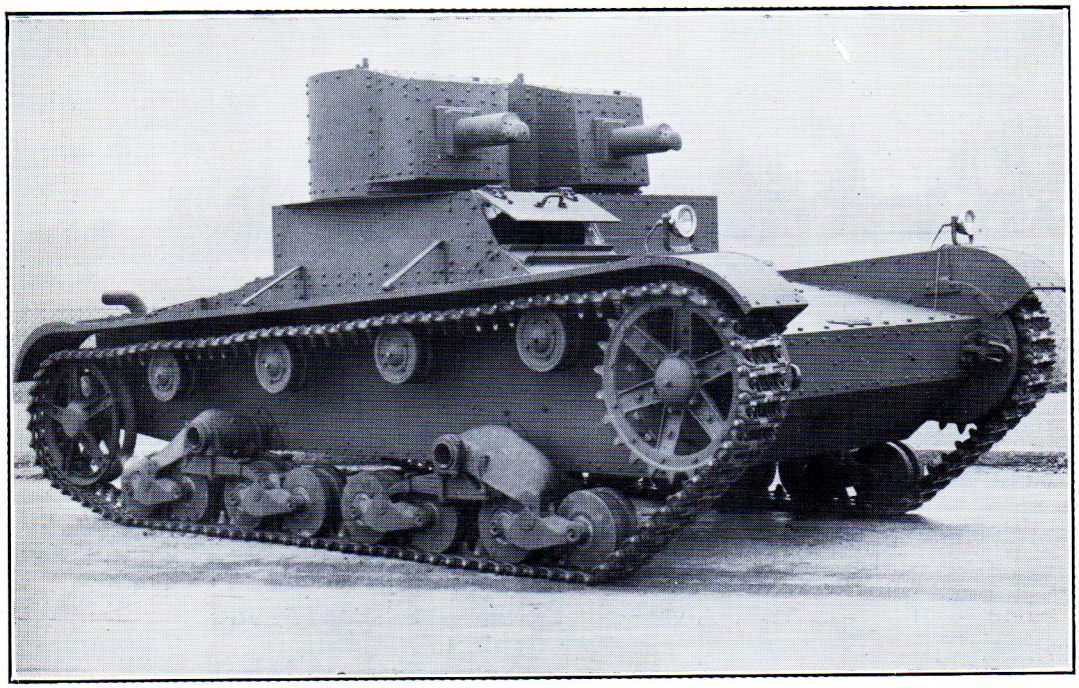

Plate V

This Tank embodies the experience of many years in the manufacture of Tanks of all sizes. **It provides the best possible combination of fire power, mobility and protection.**

SUSPENSION AND TRACK.

The suspension is of a patented type and consists of two sets of double bogies on either side of the machine and is fitted with cantilever springs. Each suspension unit is pivoted on its respective axle which passes across the whole width of the machine.

The pivoting of the bogie frames permits the rise and fall of the bogies when passing over rough ground. The complete articulation of this type of suspension ensures each wheel bearing its proportionate share of the load at all times, resulting in the equal distribution of pressure of the track on the ground.

The Tank has a powerful engine of robust construction, giving 80 H.P. at 2,000 r.p.m. and is very low — its height is only 2.1 metres overall. **It is thus able to take cover and provides a target which is very difficult to engage.**

It has a change speed box, giving 4 speeds forward and an emergency low gear, which can be used either forward, or in reverse, for towing, or negotiating specially difficult country.

Bulkheads are provided, separating the Fighting Chamber from the Engine Room and the Engine Room from the Petrol Tank Compartment.

Wireless. In addition to the machine-gun armament, the Tank can accommodate a wireless transmitting and receiving apparatus, capable, when the Tank engine is not running, of a range of about 7 to 8 kilometres for telephony, and about 11 to 12 kilometres for telegraphy.

DETAILS—6-ton Tank

Crew . . .	Three Men (one Driver and two Gunners).
Armament .	The machine is standardized to the top of the vertical plates, above which point twin turrets or a single turret can be fitted as required.

The Tank can be armed in accordance with either of the following alternatives:—

ALTERNATIVE "A".

Two separately rotating turrets.

Each of these turrets is armed with one Vickers tank-type machine gun.

In addition to the armament, wireless equipment (see Page 16) can also be carried, if desired.

ALTERNATIVE "B".

One single large turret.

The turret can be armed with one Vickers R.C. machine gun and one 47 mm. Q.F. gun, mounted together on a Duplex mounting.

This means that both guns are mounted on a common trunnion axis, in such a way that they elevate and traverse together. Either gun can be fired from a trigger on the elevating handwheel. The rotating turret gives both guns an all-round field of fire (360°).

The object of mounting a machine gun and a Quick Firing gun together in this manner is to provide a weapon for dealing with personnel and also a weapon for dealing with material, e.g., hostile tanks, or other similar targets, requiring an Armour Piercing or High Explosive shell for their destruction.

With the Duplex mounting, fire can be opened with Armour Piercing or High Explosive shell from the Quick Firing gun against the tank or machine gun emplacement, and can be followed immediately by fire from the machine gun without the necessity for relaying.

The principal difficulty experienced hitherto in delivering really effective fire from a tank with guns of different natures, such as a Quick Firing gun and a machine gun, has been the lack of any system of single control for the two guns. If the guns are independently operated, it is obvious that the small space available inside the turret of the tank makes it impossible for them to be operated by separate men, without the risk of these men seriously interfering with one another's freedom of movement. Should the two guns be operated by the same man, it is obvious that considerable delay in picking up a target is bound to occur, when changing from one gun to the other.

It is for this reason that the Duplex mounting for the machine gun and the Quick Firing gun together has been evolved. This mounting places the two guns under the control of one layer. It has been found to be the most efficient arrangement for overcoming the difficulties outlined above, and thus for enabling effective fire to be delivered without waste of ammunition.

TURRETS.

For alternative "A," the two turrets are of about 0.863 metres inside diameter.

These turrets are of Bullet Proof Steel Plate of the following thicknesses:

Sides	13 mm.
Top	5 mm.

A look-out door 5 mm. thick is fitted in the top of the turret, with suitable hinges and locking catches.

For Alternative "B," the turret has a base diameter of about 1.295 metres and plating of the same thickness as that of the two small turrets referred to under alternative "A". This turret is provided with a door in the top.

TANKS

Ammunition Storage	With Alternative "A"—R.C. Ammn.	6,000 rounds.
	If wireless equipment is carried.	4,000 rounds.
	With Alternative "B"—R.C. Ammn.	4,000 rounds.
	47 mm. Q.F. Gun ammn.	50 rounds.
Weight of Vehicle, excluding armament		6757 Kgs.
Approximate Maximum speed on the road		35 km.p.h.
Capacity of Petrol Tank		182 litres.
Width of Trench Tank can cross		1.83 metres.
Depth of Water Tank can ford		0.914 metres.
Turning Space		6.5 metres.

Maximum Dimensions :

Length	4.877 metres.
Width	2.413 metres.
Height—Armament according to Alternative "A"	2.083 metres.
Height—Armament according to Alternative "B"	2.159 metres.
Width over track shoes	2.286 metres.
Ground Clearance	0.381 metres.

Armour Plates :

Vertical sides—Fighting Chamber	13 mm.
Vertical sides—Engine Compartment	8 mm.
Vertical front and rear	13 mm.
Sloping front and rear	8 mm.
Top and Bottom	5 mm.
Turret vertical plates	13 mm.
Turret top plates	5 mm.

TANKS

(b) The Vickers-Armstrongs Medium Tank

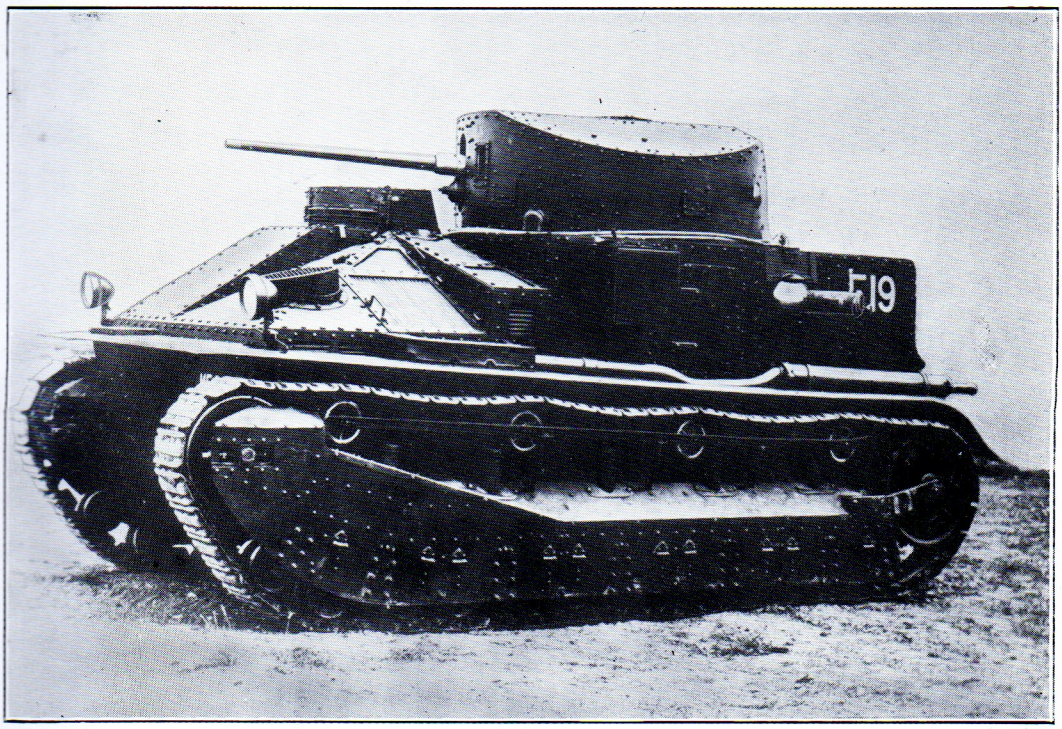

Plate VI

This is at present the **Standard Medium Tank of the British Army.**

It has an air-cooled engine, with a brake H.P. of 90 H.P. (at 1750 r.p.m.) Its overall dimensions are such that it may be transported on all standard gauge railways.

DETAILS—Medium Tank.

Crew . . .	Four Men, including the Driver.			
Armament . .	One 47 mm. Q.F. Gun.			
	Four mountings for Vickers R.C. Machine Gun.			
	Three (or four) Vickers R.C. Machine Guns.			
Ammunition Storage .	For 47 mm. Q.F. Gun—90 rounds.			
	For Machine Guns—5,000 rounds.			
Weight of Tank, excluding crew and ammunition . .	12,193 kgs.			
Maximum speed on level road	24 km. p.h.			
Capacity of Petrol Tank	*431 litres.*			
Width of Trench Tank can cross	*2 metres.*			
Depth of Water Tank can ford	*1 metre.*			
Turning Space				
Maximum Dimensions :	Length .	5.26 metres.	Height . . .	2.67 metres.
	Width .	2.69 metres.	Width over track shoes	2.63 metres.
Ground Clearance	456 mm.			
Armour Plates :	Hull .	8 mm.	Suspension protection .	6½ mm.

ARMOURED CARS

(a) Vickers-Armstrongs Light Armoured Car on Crossley 6-Wheeled Chassis

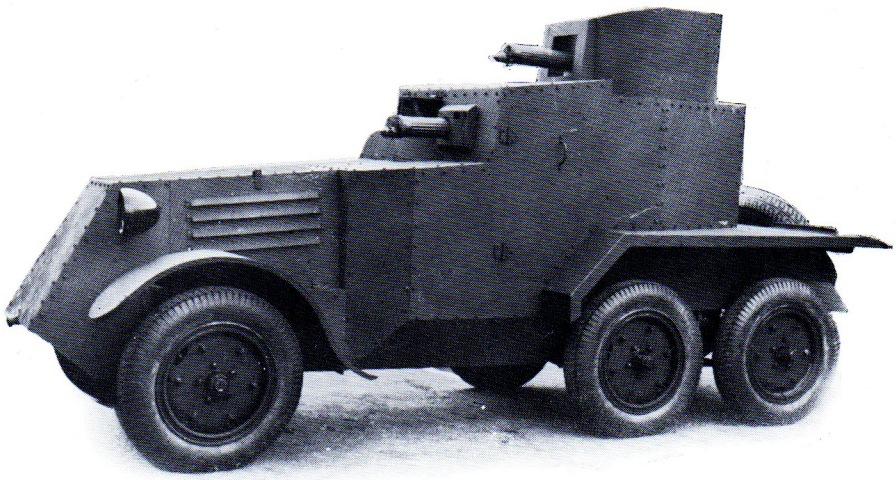

Plate VII

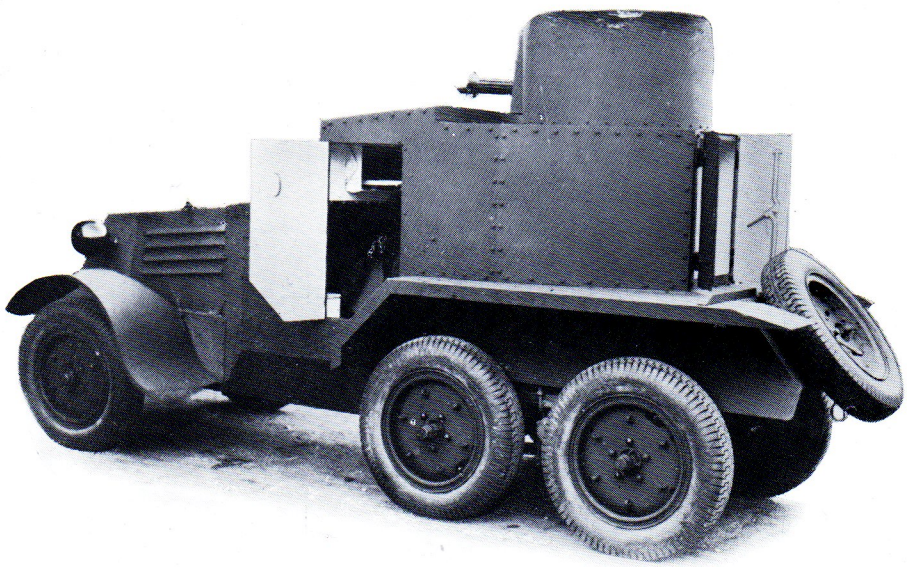

Plate VIII

This is the lightest armoured car of its range and power in the world to-day.

It has an engine which develops 50 h.p. and has a road speed of 64 kms. (40 miles) p.h.

ARMOURED CARS

The main petrol tank, which has a capacity of 20 gallons (91 litres) is entirely separate from the body of the car.

Access doors are provided at the side and rear of the car and the floor, which is of fireproof wood, is readily removable to give access to the gear box, etc.

Overall chains may be fitted over the two pairs of rear wheels for use over very rough ground.

A searchlight can be supplied if required.

Arrangements for protected vision for the driver and the two gunners can be made to suit clients' requirements and may take the form of periscopes, episcopes or interrupted slits.

DETAILS.

Crew	. .	Three Men, including Driver.
Armament	.	Two Vickers Rifle Calibre Machine Guns, with armoured water jackets. The Machine Guns are carried on Gimbal Mountings, the upper gun being mounted in the turret, which has a field of fire of 360°. A seat, which trains round with the turret, is provided for the gunner for this gun. The second gun is carried on the left of the driver's seat.
Ammunition	.	3,000 rounds.

The total weight of the vehicle, including armament, ammunition, crew, etc., is 4 tons 10 cwt. (4,420 kgs.)

Maximum Speed on the Road, 64 kms. p.h. (40 m.p h.)

Two Ditching Boards are carried on the side of the car to enable the car to pass over gullies or wide holes.

ARMOUR.

This covers all vital parts of the car, such as engine, radiator, gear box, petrol tank, etc. All the vertical plates are of 7 mm. and are thus capable of resisting ordinary Rifle and Machine Gun fire at any range.

Overall dimensions of the complete car are as follows:

Length	. 207.5 in.	5270 mm.
Breadth	. 76 in.	1930 mm.
Height	. 95.3 in.	2420 mm.

ARMOURED CARS

(b) The Vickers-Armstrongs Armoured Car on Crossley 6-wheeled Chassis

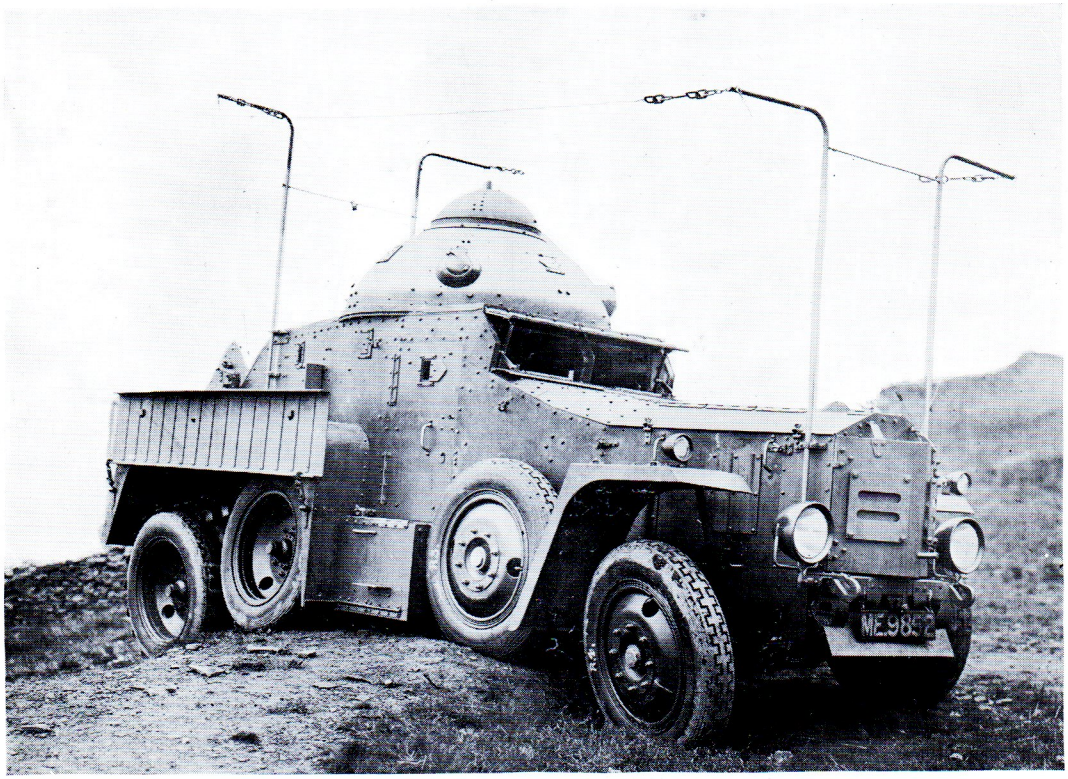

Plate IX

It should be noted that two spare wheels are carried on dummy axles, one on each side of the vehicle. These spare wheels are able to revolve on the dummy axles. As will be seen in our illustration, the position of the wheels is such that when the front wheels go into a hole or steep declivity in the ground, the weight of the vehicle is taken upon the spare wheels.

The effect of this is to enable the vehicle to cross a hole or trench wider by the distance between the front axle and the dummy axle than would otherwise be possible. The trench crossing capacity of the armoured car is thus increased by means of the dummy axle to a distance of 1.07 m. (3' 6")

A peephole with a sliding shutter is provided for the driver, and large flaps which can be opened to give a wider view when not under fire.

Access doors are situated at the sides and rear of the car.

The body and turret of the car is lined with asbestos.

The car shown in the illustration is fitted with wireless apparatus.

ARMOURED CARS

DETAILS.

Crew - - Four Men.

Armament - Two Vickers R.C. Machine Guns, with Armoured Water Jackets.

Four Machine Gun Mountings are provided, the attachments for the guns being so arranged that the position of the latter may be instantly changed.

Ammunition - 6,000 rounds.

Total weight of the Vehicle, including Armament, Ammunition, and Crew—7,503 kgs.

Maximum Speed on the Road—80 kms. (50 miles) per hour.

Circuit of Action—The car carries 113 litres of petrol and has a circuit of action of 240 kilometres.

Two Ditching Boards are carried, to enable the Car to pass over gullies or wide holes.

Overall Chains for the two pairs of rear wheels are provided, for use over soft ground.

Armour - - Covers the vital parts, such as Engine, Radiator, Gear Box, Petrol Tank, etc., and will keep out rifle fire at all ranges.

4. SELF-PROPELLED GUN MOUNTINGS

(a) The Vickers-Armstrongs 40 mm. Automatic Gun on Crossley 6-wheeled Chassis

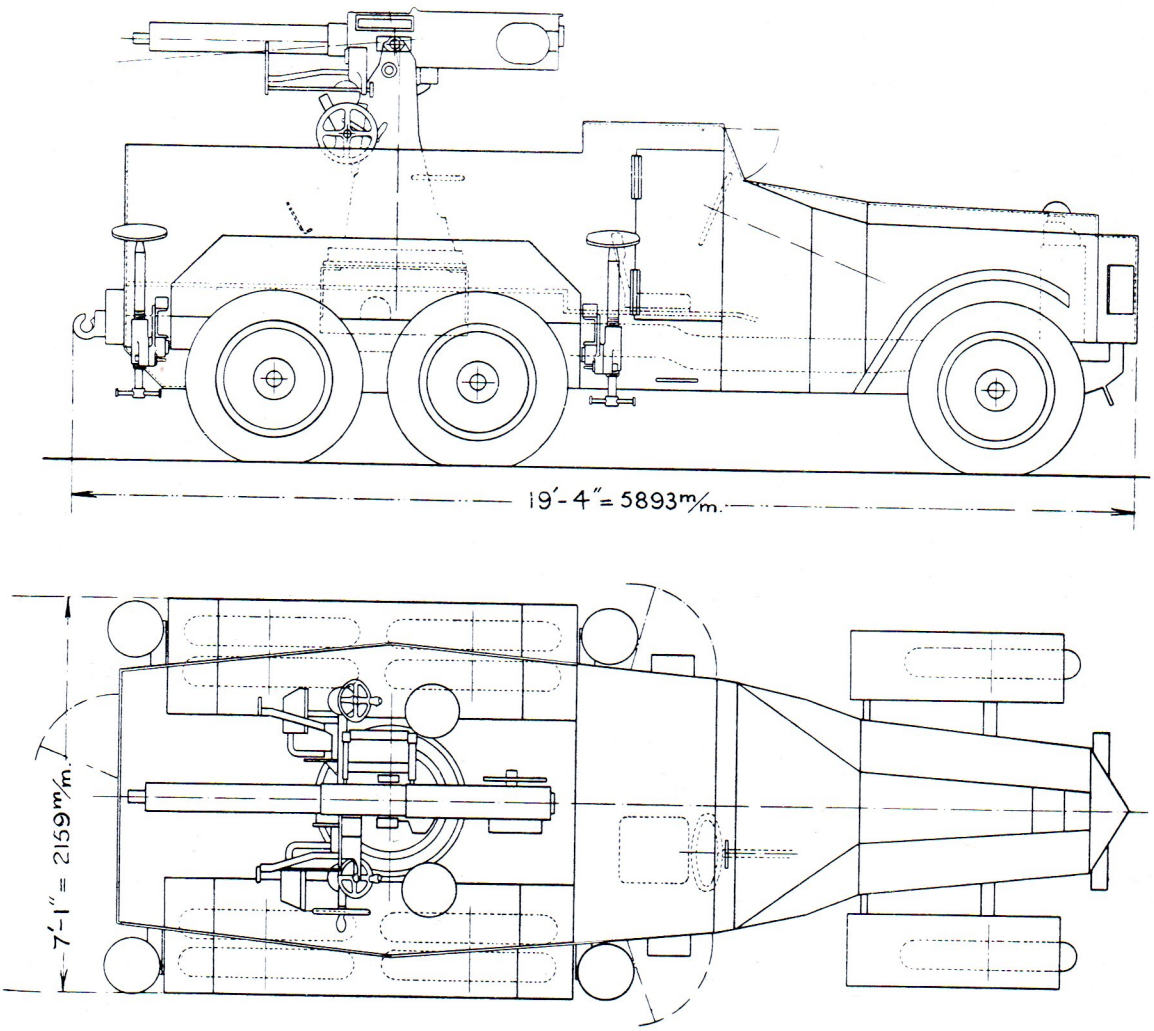

Plate X

This 40 mm. Automatic Gun has a maximum elevation of 80° with all-round traverse and is capable of fire at 200 rounds a minute.

Four screw jacks are fitted, two on each side of the car, to give steadiness during fire. The lowering of the screw jacks from the travelling position to the ground, and the final adjustment by means of the screw, takes a few minutes only.

SELF-PROPELLED GUN MOUNTINGS

DETAILS

Crew . .	Five Men.
Armament .	One Vickers-Armstrongs 40 mm. Automatic Gun on **A.A.** Mounting.
Ammunition .	200 rounds can be carried in the Car.
Total Weight of Vehicle, including Armament, Ammunition and Crew—	7,238 kgs.
Armour . .	5 mm. Bullet-Proof Plate, so arranged as completely to protect the Driver and the Radiator, Petrol Tank and Engine. The Armour of the body is sufficiently high to enable the Gun Crew to take shelter when not working the gun.

SECTION II

THE ARMOURING OF FIGHTING VEHICLES

THE ARMOURING OF FIGHTING VEHICLES

The principal requirements of an Armoured Fighting Vehicle are :—

Fire Power.

Mobility.

Protection.

In the Vehicles described in Section I, **Fire Power** is provided for by different combinations of Machine Guns, both of rifle and heavier calibre, and of Guns.

Mobility is ensured by the efficiency of the engines and the perfection in design and the manufacture of the transmission, suspension and tracks, for which Vickers-Armstrongs hold a world-wide reputation.

Protection, apart from that which the movement provides, depends upon the quality of the **bullet-proof plate,** of which the Armour of the Vehicle is made.

Vickers-Armstrongs are now in a position to provide bullet-proof plate of improved quality. This plate is the fruit of prolonged research carried out at the " Vickers Works " in Sheffield.

This new plate, known as **C.T.A. Plate,** has been thoroughly tested against several natures of ammunition, and has given extremely satisfactory results.

The importance of these results is very great. The use of the **C.T.A. Bullet-proof Plates** will reduce considerably the weight of Armour which the Tank, or Armoured Car Chassis will have to carry, and will thus reduce also the work which the engine has to perform. For it will be seen that a **C.T.A. Plate** of 11 mm. is proof against the 7.92 mm. Mauser Armour-piercing bullet at all ranges, while formerly it required a 15 mm. plate to withstand this attack.

This means that for the same degree of protection, there will be a saving in weight of armour of nearly 27 per cent.

Tabular Statement of Results obtained with C.T.A. Plate, as compared to ordinary Bullet-proof Plate.

C.T.A. Plate of the following thickness	is proof against	* (1) British 7.7 mm. Ammun. at the following ranges :	* (2) Polish Mauser 7.92 mm. Ammun. at the following ranges :	* (3) British 12.7 mm. Ammun. at the following ranges :	* (4) British High Velocity 12.7 mm. Ammun. at the following ranges :	* (5) British High Velocity 12.7 mm. Ammun., with special bullet, at the following ranges :	The thickness of the ordinary bullet-proof plate, which is necessary to keep out these natures of ammunition at the same ranges :
7 mm.		250 m.	350 m.				11.0 mm.
8 mm.		250 m.	300 m.				12.0 mm.
9 mm.		150 m.	250 m.				13.0 mm.
11 mm.			All	450 m.			15.0 mm.
14 mm.			Ranges	200 m.			17.0 mm.
17 mm.				100 m.	450 m.	350 m.	20.0 mm.

---

* The Ammunition in every case is Armour Piercing.	Weight of Bullet.	Velocity at 25 m.
(1) British . . .	11.27 grammes	728.5 metres per sec.
(2) Polish Mauser . .	11.47 do.	844 do.
(3) British Standard . .	36.6 do.	756 do.
(4) British High Velocity .	43.0 do.	917 do.
(5) British High Velocity with streamlined bullet .	49.9 do.	854 do.

SECTION III

INTERNAL COMMUNICATION IN TANKS

INTERNAL COMMUNICATION IN TANKS

For the purposes of internal communication in tanks, between the Commander of the tank and his driver and gunners and vice versa, Messrs. Vickers-Armstrongs are now able to offer a special type of noise-excluding Laryngaphone, which has been expressly designed for this purpose and is of particularly robust construction.

Plate XI

Plate XI illustrates the use of the tank type Laryngaphone set, in the interior of the Vickers-Armstrongs 6-ton tank.

The Laryngaphone consists of:

A telephone fitted with a patented noise-proof transmitter, which excludes all extraneous sounds.

Each head-set comprises two receivers held over the ears by head-bands, and a noise-proof Laryngaphone transmitter, which is kept in contact with the side of the face as illustrated.

In practice a head-set, with the addition of a special "Transmitter switch" is supplied for the use of as many members of the crew as may be required. The

circuit arrangement provides the Commander of the tank with direct and instantaneous communication to his Driver and Gunners, and vice versa. No inter-communication can take place between the subordinate members of the crew.

The Transmitters of the subordinate members of the crew, are normally cut out of circuit by the "Transmitter Switch."

The switch can be attached to a tunic button or pocket, a length of robust army type flexible cable, with a 4-pin "concentric" plug making connection to the permanent wiring of the installation.

Besides making "reverse" connections impossible—the concentric plug provided will also give connection between a rotating turret and the floor of a Tank.

For connecting the head-set to the permanent wiring of the Tank, a metal junction box is provided. This is fitted with line terminals and a socket to take the head-set plug. It is of very robust construction, and will withstand the roughest usage.

If required a leather pouch can also be supplied for storing the head-set when not in use, being fixed usually to some portion of the Tank's structure adjacent to the user's station.

For the permanent wiring of the installation an oil-resisting, tough rubber covered, flexible cable is recommended, in preference to armoured cable, because of its superior insulating properties.

Operating current is normally supplied by a 6-volt dry cell battery. If required, however, current may be taken from the Tank lighting set, although to provide against possible breakdown it is advisable that a separate battery should be used.

It is important that enquiries and orders should specify the total number of the crew of the Tank, including the Commander, and details of the circuit requirements.

SECTION IV

TRACTORS

TRACTORS

(1) The Carden-Loyd used as a Tractor, towing the Carden-Loyd Trailer

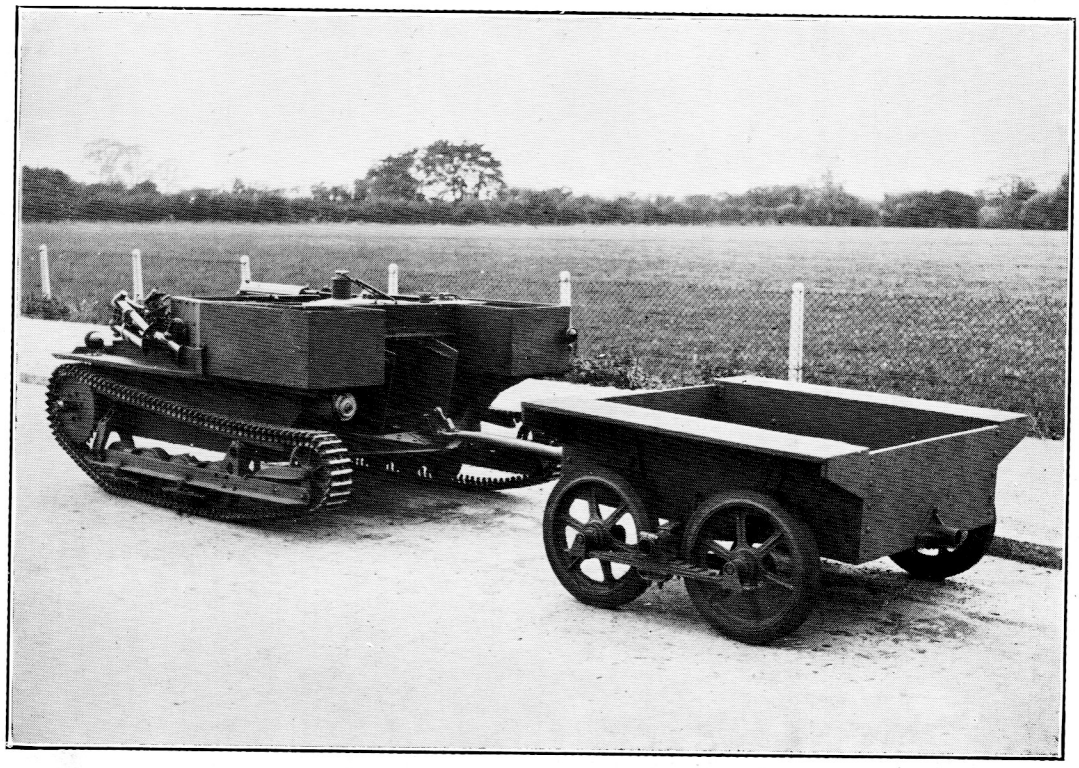

Plate XII

Employed in this manner, the Carden-Loyd vehicle is able to pull, in addition to its full load, a load of 500 kgs.

Its speed on good roads, with the Trailer carrying a load of 500 kgs., is approximately 25 km. p.h.

Dimensions of the Trailer.

Overall Height	0.737 m.
Do. Width	1.549 m.
Do. Length, including Drawbar Tube ...	2.565 m.
Do. Length, with Drawbar Tube removed	1.42 m.

Space inside Body—

Length	1.281 m.
Width	0.977 m.
Depth	0.349 m.

Special Trailers for the transport of Personnel, Wireless Apparatus, Water, Rations, Ammunition, Petrol, etc., can be built to fulfil any requirements.

TRACTORS

(2) The Carden-Loyd used as an Artillery Tractor, pulling a 95 mm. Howitzer, carried on Carden-Loyd Special Track-mounted sprung Transporter

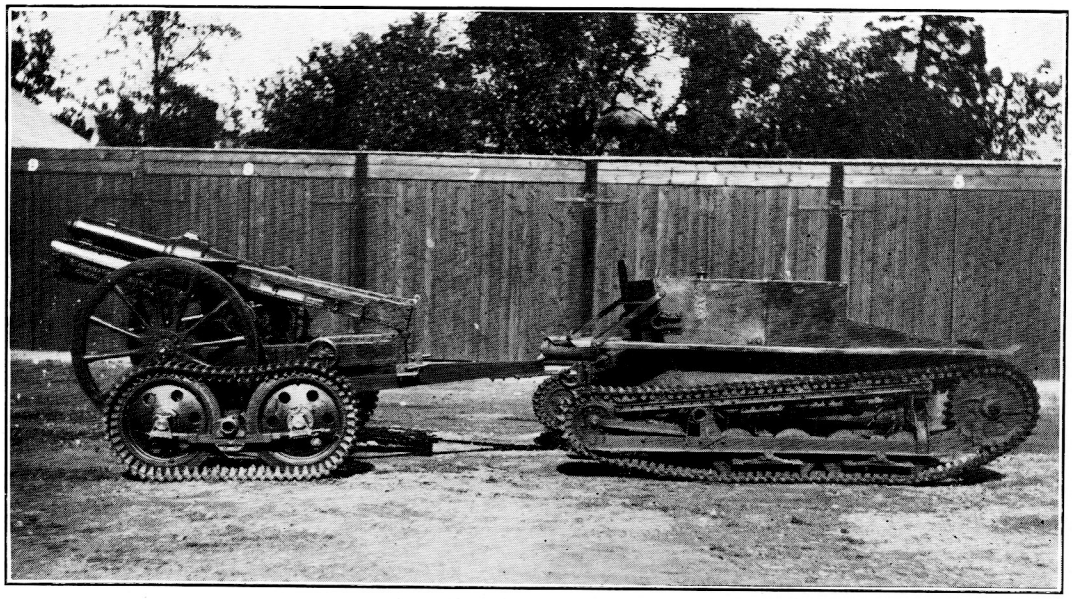

Plate XIII

The vehicle is shown drawing the 3.7in. (95 mm.) Mountain Howitzer of the British Artillery. The total weight of this Howitzer is 780 kgs.

TRACTORS

(3) The Carden-Loyd Light Tractor

Designed for use as a field artillery tractor. It is extremely low and inconspicuous, very easy to drive and, unlike other machines has seating accommodation for five men and may be arranged to carry a further five men and ammunition.

The tractor has a six cylinder water-cooled engine, which develops 50 horse power.

The cooling arrangements are adequate for use in tropical climates.

The suspension is of a patented type and consists of two sets of well sprung bogies on either side of the machine, each suspension unit being pivoted on its own tubular axle passing right through the hull and carrying the corresponding unit the other side.

The pivoting of the bogie frames permits the rise and fall of the bogies when passing over rough ground. The excellent articulation secured by this type of suspension ensures each bogie wheel bearing its proportionate share of the load at all times, resulting in the equal distribution of pressure of the track on the ground.

TRACTORS

The Carden-Loyd Light Tractor

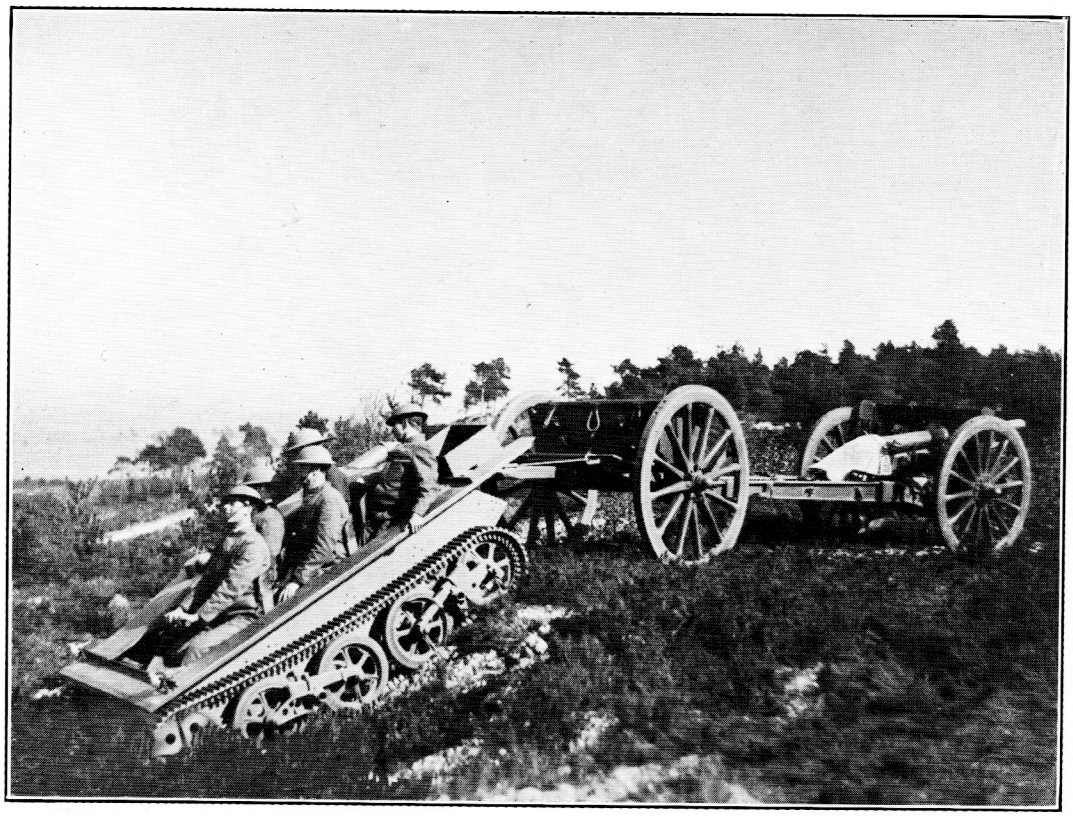

Plate XIV

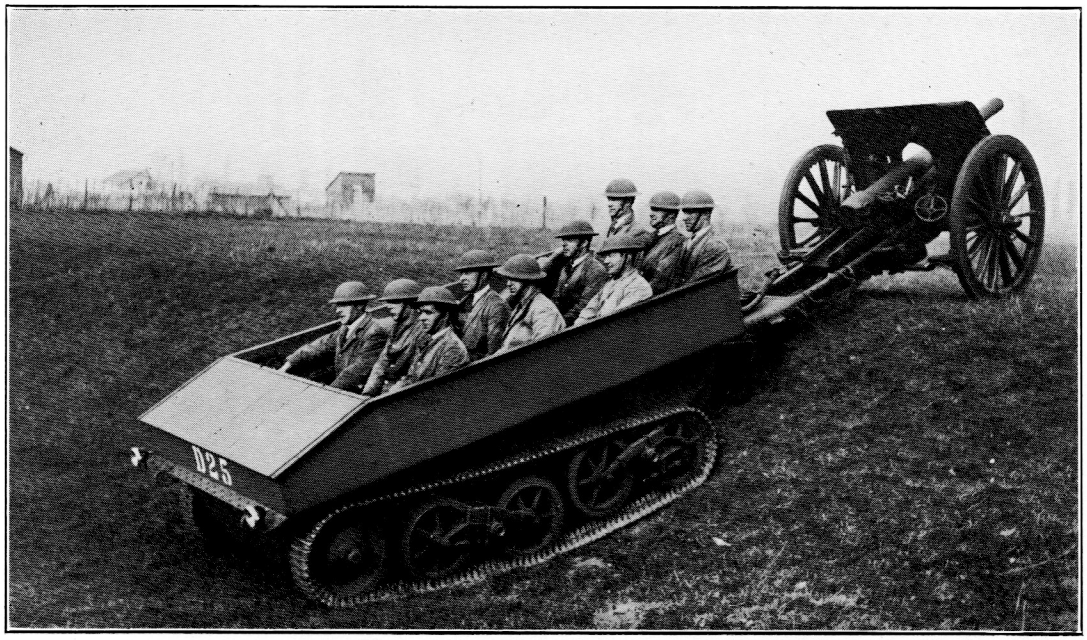

Plate XV

Special Carden-Loyd Light Tractor modified to carry ten men and cross water up to 3ft. 6in. deep.

TRACTORS

The Carden-Loyd Light Tractor

DETAILS

* Crew	* 5 men including driver	
Horse Power of Engine	50 BHP.	
Approx. Weight of Tractor	2 tons 12 cwt.	2642 kgs.
Approx. Speed on level road	25 m.p.h.	40.2 k.p.h.
Petrol capacity	25 gallons	113.5 litres
Oil capacity	4 „	18 „
Width of Trench Tractor can cross	4 ft.	1.22 m.
* Depth of Water Tractor can ford	2 ft. 6 in.	0·75 m.

Hauling Capacity :

2 tons 2 cwt.	(2150 kgs.)	up	18 degree slope (1 in 3.2)	on fair surface
3 tons 15 cwt.	(3850 kgs.)	up	15 degree slope (1 in 3.9)	
6 tons 11 cwt.	(6675 kgs.)	up	9½ degree slope (1 in 6)	

Maximum Dimensions :

Length	12 ft. 0 ins.	3.65 m.
Width	6 ft. 2 ins.	1.87 m.
Height	4 ft. 3 ins.	1.26 m.
Turning Space, Tractor alone	18 ft.	5.48 m.

* A special tractor can be supplied to take up to 10 men and cross water up to 3ft. 6in. = 1.06 m.

TRACTORS

(4) The Carden-Loyd Tractor Truck

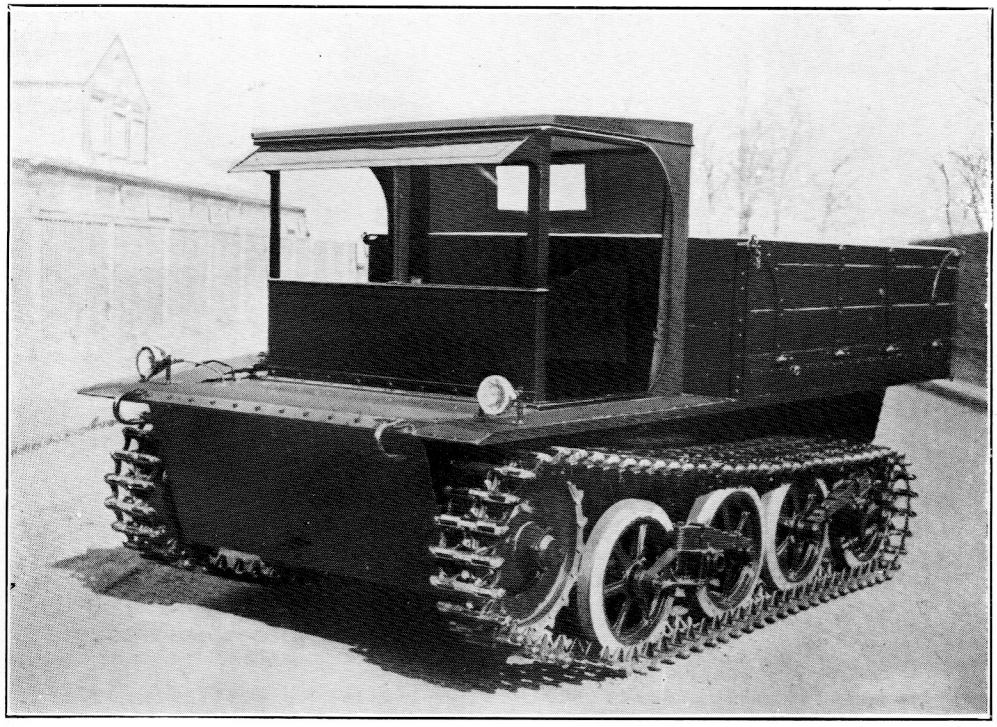

Plate XVI

The Tractor Truck's cross country performance is remarkable.

When driving on the road the tracks cause no damage whatever to the road surface as the perfect articulation of these tracks give tremendous tractive effort without the necessity of employing spuds.

This machine which has an identical chassis to the Carden-Loyd Light Tractor described on preceding pages, has cooling arrangements designed for hot climates and has very wide commercial applications.

It is an all purpose machine, a tractor and light truck in one. Its value in congested places such as docks, railway yards, mines and forests is tremendous. It can also be adapted to carry and drive any special tool.

It is equally suitable for running on blown sand or very wet ground and on account of its capabilities as a full tracked machine of instantaneous change of direction it is invaluable for use on narrow mountain roads and tracks, etc.

TRACTORS

The Carden-Loyd Tractor Truck

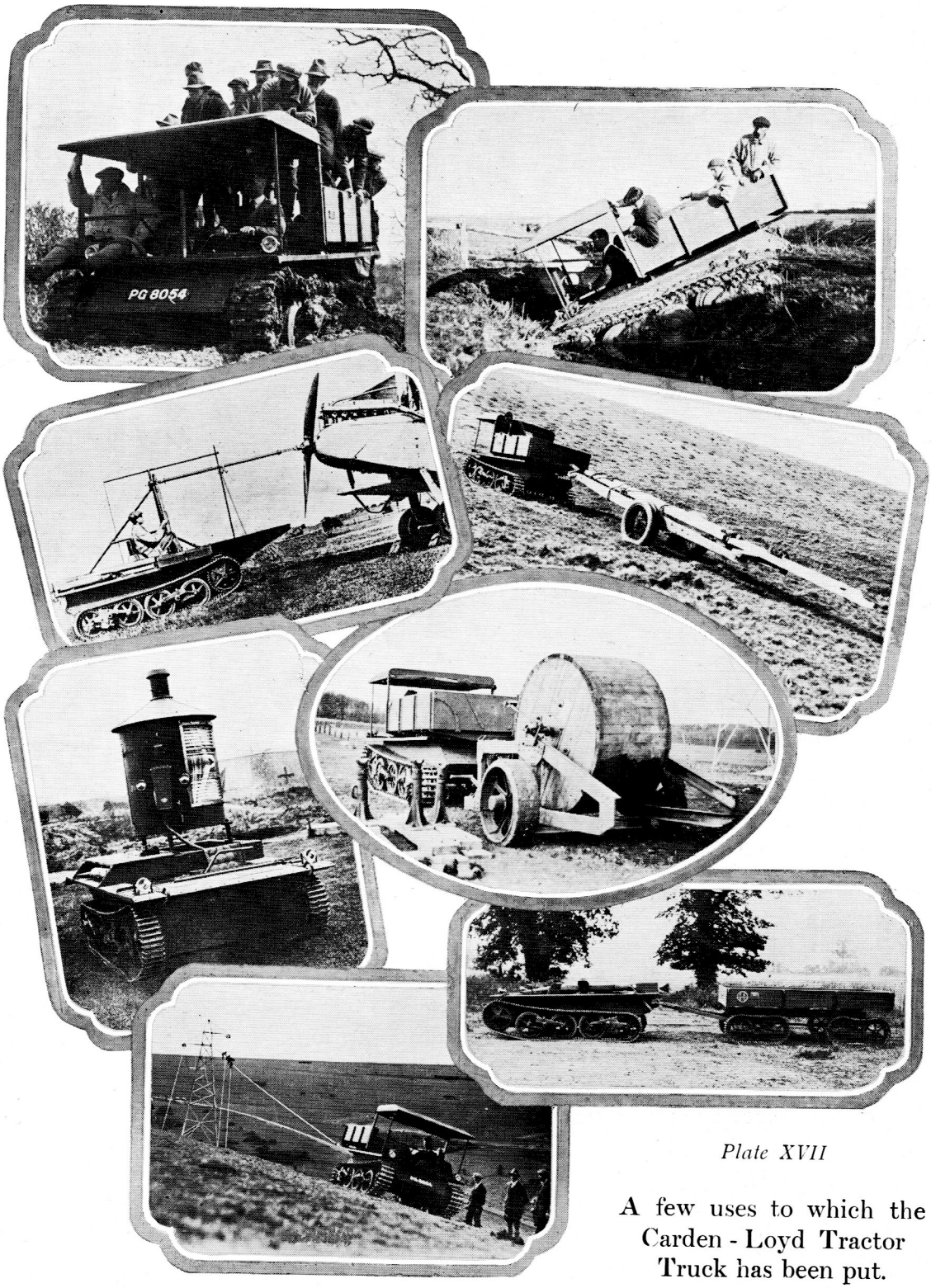

Plate XVII

A few uses to which the Carden - Loyd Tractor Truck has been put.

TRACTORS

The Carden-Loyd Tractor Truck

DETAILS

Approx. Weight	2 tons 15 cwt.	2794 kgs.
Horse Power of Engine	50 BHP.	
Load capacity of Truck Body	1 ton 10 cwt.	1524 kgs.
Speed on level road	15 to 25 m.p.h.	24 to 40 k.p.h.
Petrol capacity	25 gallons	113.5 litres.
Oil capacity	4 gallons	18 litres.
Width of Trench machine will cross	4 ft.	1.22 m.
Depth of Water Machine will ford	2 ft. 6 ins.	0.75 m.

Hauling Capacity :

2 tons 2 cwt.	(2150 kgs.)	up	18 degree slope (1 in 3.2)	on fair surface
3 tons 15 cwt.	(3850 kgs.)	up	15 degree slope (1 in 3.9)	
6 tons 11 cwt.	(6675 kgs.)	up	9½ degree slope (1 in 6)	

Maximum Dimensions :

Length	12 ft. 0 ins.	3.65 m.
Width	6 ft. 2 ins.	1.87 m.
Height (to top of driver's cab)	6 ft. 2 ins.	1.87 m.
Height (to top of Truck sides)	4 ft. 9 ins.	1.44 m.

Dimensions of Truck Body :

Length inside body	6 ft. 4 ins.	1.92 m.
Width inside body	5 ft. 11 ins.	1.80 m.

TRACTORS

(5) Vickers-Armstrongs Tractor

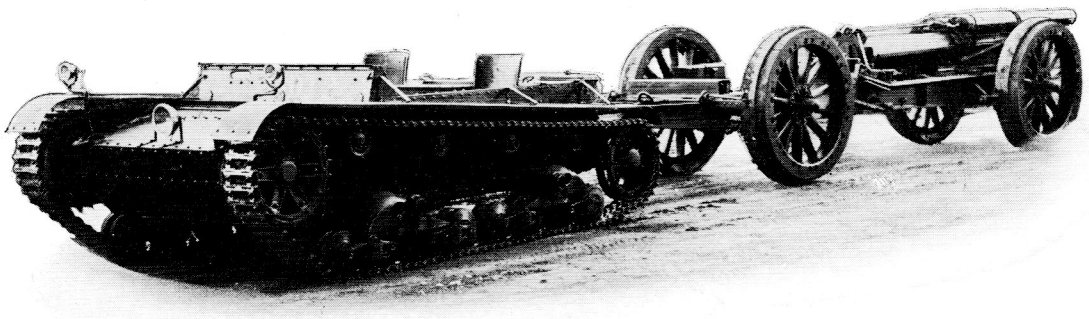

Plate XVIII

This Tractor is designed to draw heavy field artillery at the speeds required by modern mechanized armies.

The engine is a four-cylinder air-cooled engine, which develops 80 horse power in 2000 revolutions per minute.

The change speed gear box has five speeds forward, and one in reverse.

An electric motor for starting the engine is provided.

The driver's seat is situated in the centre of the machine and gives a good view of the ground.

Steering is effected by clutches and brakes.

The suspension is of a patented type and consists of two sets of double bogies on either side of the machine fitted with cantilever springs. Each suspension unit is pivoted on its respective axle which passes right across the machine.

The pivoting of the bogie frames permits the rise and fall of the bogies when passing over rough ground. The complete articulation of this type of suspension ensures each wheel bearing its proportionate share of the load at all times, resulting in equal distribution of track pressure on the ground.

The Tractor's cross country performance is remarkable and when running on the road it causes no damage.

TRACTORS

Vickers-Armstrongs Tractor

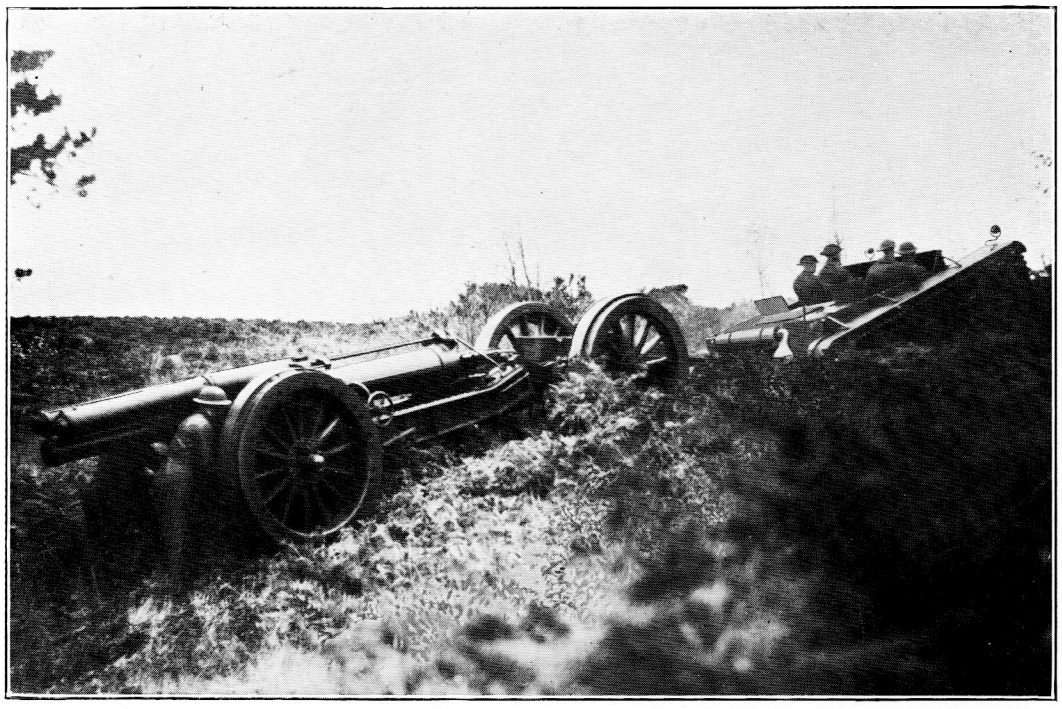

Plate XIX

The hull can be arranged to give a well space of about 60 cubic feet (1.7 cu. m.) and to carry 10 men besides the driver with a load of 1½ tons (1524 kgs.) of stores or ammunition.

If desired, platforms can be arranged on the top of the hull for carrying bulky loads, leaving only space for the driver and free access for air to the engine cooling fan inlet.

The weight of the load which the machine can carry across country, subject to space being available, is 2¼ tons (2286 kgs.). It can at the same time haul a loaded trailer weighing, with its load, 7 tons (7112 kgs.).

Many variations of the above scheme of loading can be arranged and greater loads up to 12 tons (12,192 kgs.) can be hauled depending only on the maximum gradients encountered.

TRACTORS

Vickers-Armstrongs Tractor

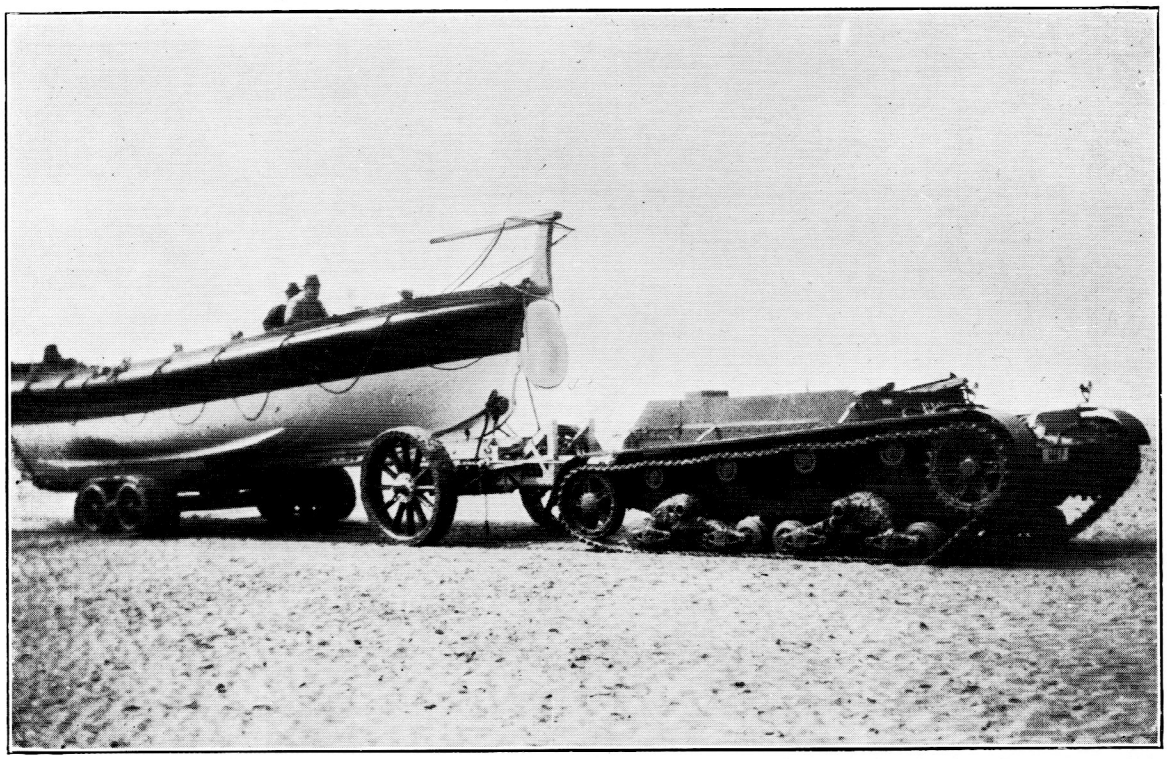

Plate XX

Plate **XX** shows the Tractor pulling a lifeboat on a half-track trailer on muddy sand, the weight of the boat and trailer together being **12** tons (**12,192** kgs.).

From the above it is obvious that in addition to its purely military use, the commercial applications of this remarkable vehicle are very numerous.

TRACTORS

Vickers-Armstrongs Tractor

DETAILS

Weight of Tractor . . .	5690 kgs.
Approximate maximum speed on level road	30 k.p.h.
Capacity of Petrol Tank . . .	291 litres (64 gallons).
Width of trench Tractor can cross . .	1.83 metres.
Depth of water Tractor can ford . .	0.914 metres.
Height of Obstacle Tractor can surmount .	0.762 metres.
Turning Space	6.5 metres.

Maximum Dimensions:

Length	4.75 metres.
Width	2.413 metres.
Width over track shoes . . .	2.286 metres.
Ground Clearance	38 cms.

Hauling Capacity:

With a load in the Tractor of 2500 kgs. it will haul a load

of 3,000 kgs. up a slope of 22° or 1 in 2.7
of 6,000 kgs. ,, ,, 15° or 1 in 3.9
of 10,000 kgs. ,, ,, $9\frac{1}{2}$° or 1 in 6
of 12,200 kgs. ,, ,, $4\frac{3}{4}$° or 1 in 12

SECTION V

LORRIES

LORRIES

(1) The Vickers-Armstrongs Crossley Light 6-Wheeled Lorry (Semi-Forward Control)

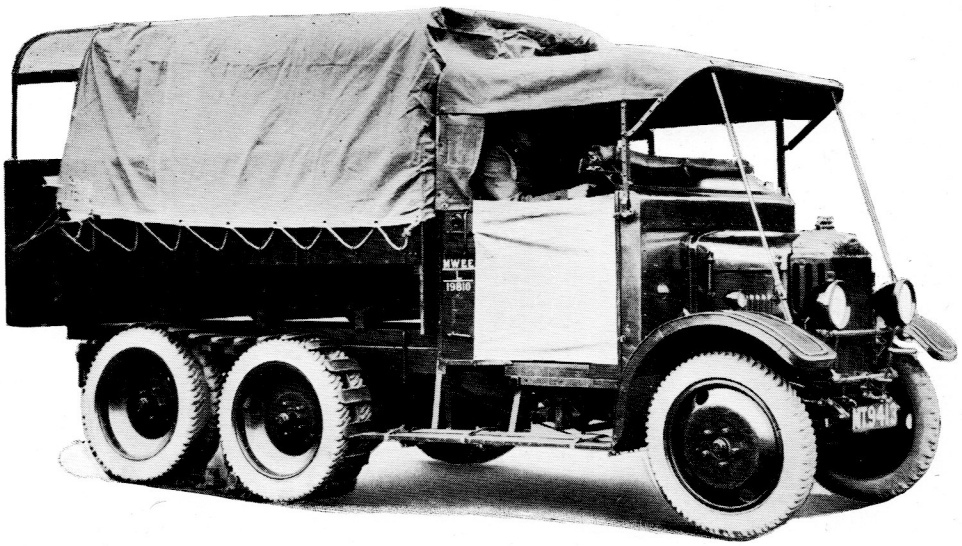

Plate XXI

As a result of their great experience in studying the uses of mechanical vehicles in every part of the world, Vickers-Armstrongs have come to an arrangement with Messrs. Crossley Motors, Ltd., whereby they are enabled to offer the above Lorry for both military and commercial purposes.

This Lorry is the fruit of experience extending over many years in the construction of Lorries for military uses. Its cross-country capacity is remarkable.

It is provided with an engine developing over 50 H.P. (50 *chevaux vapeur*), and has four forward speeds and one reverse for normal use, and a further extra low gear range of four speeds for use under extreme conditions.

Hand and foot brakes are provided, both of which act on all four driving wheels.

The forward position of the driver gives an uninterrupted view of the ground and greatly facilitates cross-country driving.

LORRIES

DETAILS

Dimensions :—

Wheel-base (to centre of Bogie)—3.05 m.

Distance between Bogie Axle Centres—1 m.

Wheel Track (Front)—1.45 m.

Wheel Track (Rear)—1.8 m.

Frame Length behind Dashboard—4.18 m.

Ground Clearance under Front Axle—0.304 m.

Chassis Weight*—2,281 kg.

Front Axle Weight* (unladen)—811 kg.

Driving Axle Weight* (equally distributed on the Bogie)—1,570 kg.

Petrol Capacity—68.19 litres.

*All these weights are with Water, Oil and Petrol Tanks full.

LORRIES

(2) The Vickers-Armstrongs Thornycroft 6-wheeled Lorry (Forward Control)

Plate XXII

As a result of their great experience in studying the uses of mechanical vehicles in every part of the world, Vickers-Armstrongs have come to an arrangement with Messrs. Thornycroft & Co., whereby they are enabled to offer the above Lorry for both military and commercial purposes.

This Lorry represents the most advanced type of Heavy Lorry construction, and is specially designed for work in undeveloped countries where the roads are bad or non-existent. It has already been supplied in large numbers for use in South Africa and South America and in British India.

It is provided with an engine developing 70 H.P. *(70 chevaux vapeur)*, and has four forward speeds and reverse. The highest gear gives a road speed, at 1,500 r.p.m., of 28 km. p.h. Hand and foot brakes are provided. The foot brake, which is assisted by vacuum-servo cylinder, operates on the wheels of the rearmost driving axle. The hand brake operates on the forward driving wheels. Both brakes take effect on all four wheels of the bogie by means of a coupling shaft.

The rear suspension is of patented design, to give even distribution of weight on all four wheels and freedom from spring distortion.

The forward position of the driver gives an uninterrupted view of the ground and greatly facilitates cross-country driving.

LORRIES

DETAILS

Wheel-base	3.05 m. and 1.22 m.
Bogie	1.22 m.
Wheel Track (Front) . . .	1.55 m.
Wheel Track (Rear) . . .	1.54 m.
Ground Clearance under Front Axle .	29.8 cm.
Chassis Weight (unladen) . . .	3556.17 kgs.
Front Axle Weight (unladen) . .	1740 kgs.
Driving Axle Weight (unladen on Bogie, equally distributed) . . .	1816.17 kgs.
Petrol Capacity	95.47 litres.

Plate XXIII

SECTION VI

TRAILERS

TRAILERS

(1) The Carden-Loyd Trailer

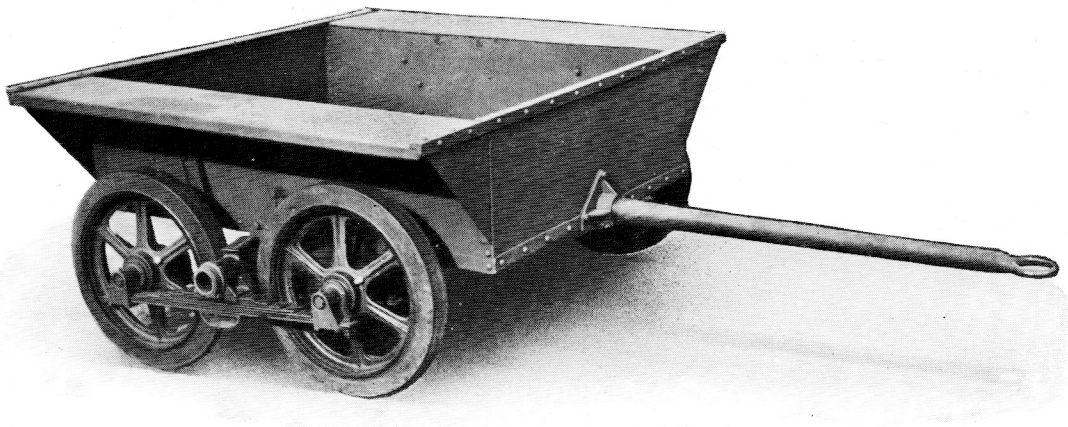

Plate XXIV

A light track can be supplied for this trailer when used under exceptional conditions.

Dimensions of the Trailer

Overall Height	. . . . .	0.737 m.
,, Width	. . . . .	1.549 m.
,, Length, including Drawbar Tube	. .	2.565 m.
,, Length, with Drawbar Tube removed	.	1.42 m.

Space inside Body :

Length	. . . . .	1.281 m.
Width	. . . . .	0.977 m.
Depth	. . . . .	0.349 m.

Special Trailers for the transport of Personnel, Wireless Apparatus, Water, Rations, Ammunition, Petrol, etc., can be supplied.

TRAILERS

(2) The Carden-Loyd Special Transporter

The Transporter is **light, strong and cheap.** Considered in relation to the saving in track life which it ensures, **its cost is negligible.**

The Carden-Loyd, mounted as shown on the Transporter, can be towed behind the Vickers-Armstrongs-Crossley Light 6-wheeled Lorry when fully loaded without any effect on the speed of the Lorry.

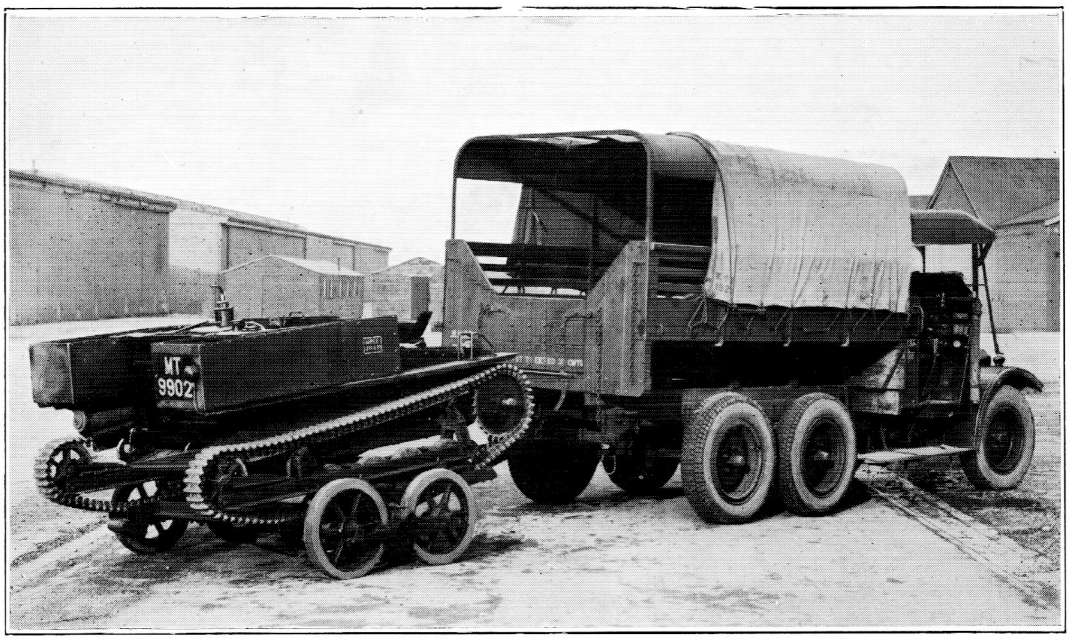

Plate XXV

The above illustrates the method of towing the Carden-Loyd on its Special Transporter behind the Vickers-Armstrongs Crossley Light 6-wheeled Lorry.

TRAILERS

(3) The Vickers-Armstrongs 4-wheeled Trailer

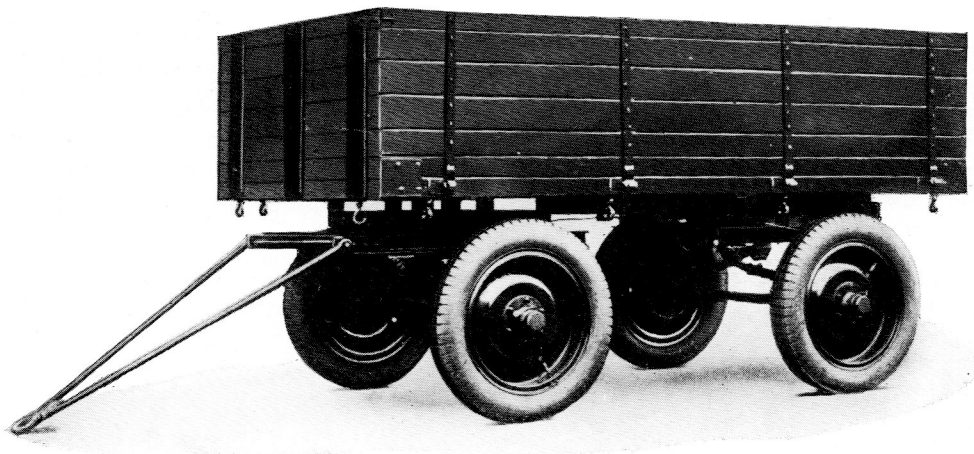

Plate XXVI

This Trailer, which is suitable for attachment to either of the Lorries illustrated on pages 48 and 50, can be supplied in sizes varying in capacity from 2,000 to 10,000 kgs.

The Trailer shown in the illustration has a capacity of 2,000 kgs.

DETAILS

Dimensions :—

2,000 kg.	capacity—	complete	with	body –	3,276.5 mm. × 1,676.4 mm. × 304.8 mm.
3–4,000 kg.	,,	,,	,,	,,	3,505.1 mm. × 1,828.8 mm. × 457.2 mm.
4–5,000 kg.	,,	,,	,,	,,	3,657.5 mm. × 1,905.0 mm. × 533.4 mm.
5,000 kg.	,,	,,	,,	,,	3,809.9 mm. × 1,981.2 mm. × 533.4 mm.
6,000 kg.	,,	,,	,,	,,	3,962.3 mm. × 2,133.6 mm. × 581.5 mm.
8,000 kg.	,,	,,	,,	,,	4,190.9 mm. × 2,133.6 mm. × 723.9 mm.
10,000 kg.	,,	,,	,,	,,	4,495.7 mm. × 2,209.8 mm. × 762.0 mm.

TRAILERS

(4) The Carden-Loyd Gun Carrier-Limber

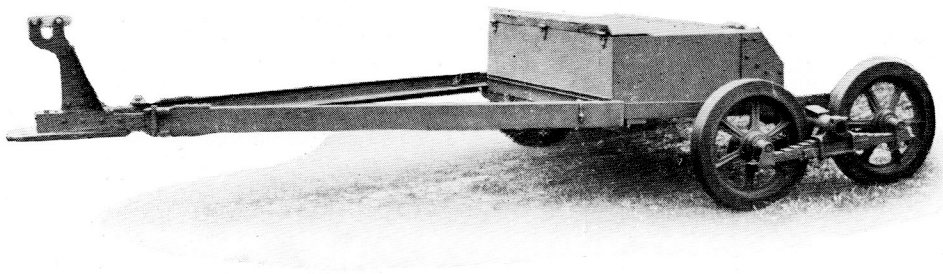

Plate XXVII

Owing to to the risk of damage to the sighting and other delicate portions of the mechanism of a gun carriage, due to vibration, it is not possible to tow guns at high speeds for long distances, even on the smoothest roads.

The Carden-Loyd Gun Carrier-Limber has been designed to overcome the above difficulty. As its name implies, it combines the functions of a transporter for the gun with that of an ammunition limber.

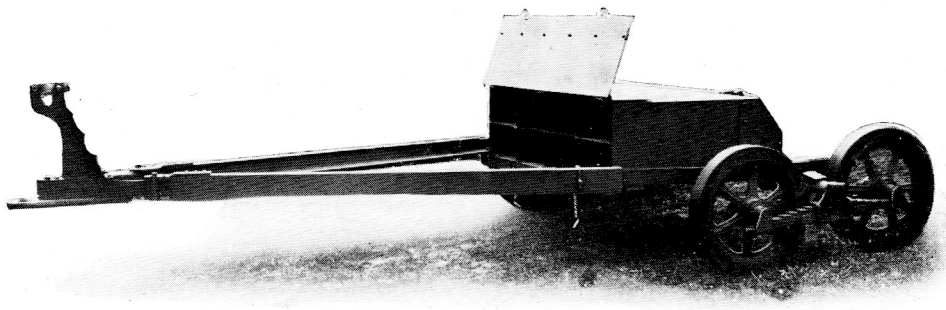

Plate XXVIII

Plate **XXVIII** shows the gun carrier-limber with limber box open.

The capacity of this limber box is 30 rounds of ordinary 75 mm. fixed ammunition, and is thus greater than that of the ordinary field gun limber.

TRAILERS

The Carden-Loyd Gun Carrier-Limber

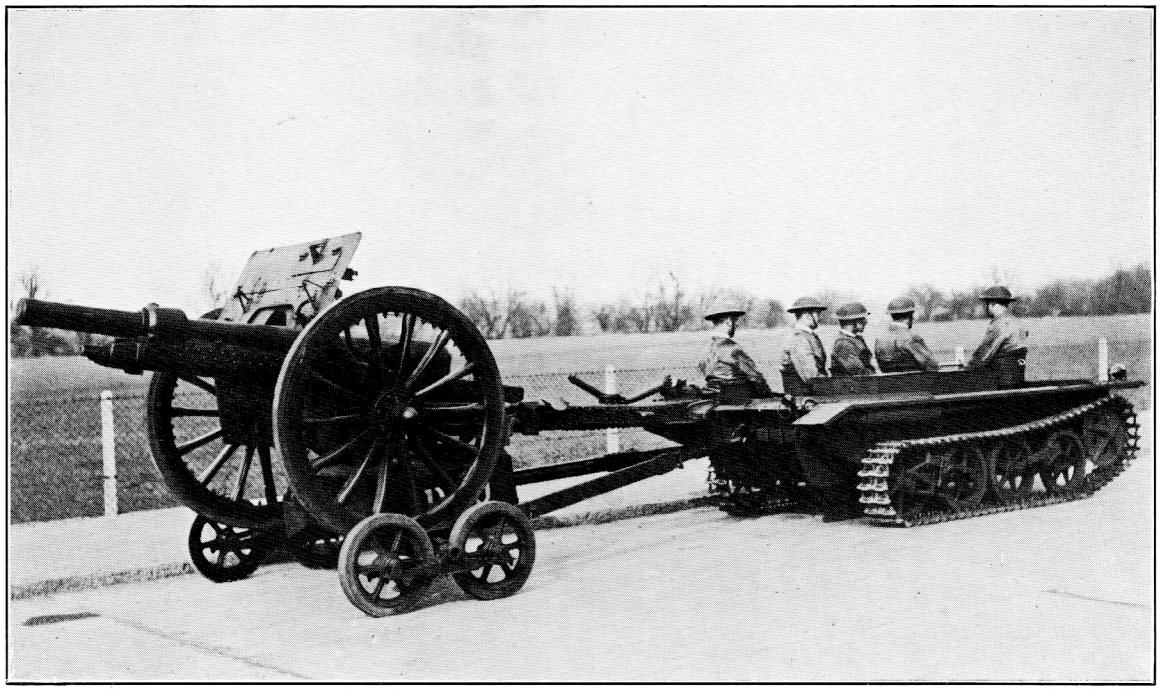

Plate XXIX

The gun is run on to the carrier by hauling it up ramps which are attached to the forward frame members of the carrier after loading. When in position the gun is secured by means of a special anchorage on the carrier which receives the trailer. A special hauling bar is provided which enables the trailer to be handled easily when running on or off the carrier.

The gun is only intended to be placed on the carrier-limber for transport on the road. It can then be towed at a speed of 20 m.p.h. (32 km.p.h.) without any difficulty.

The important **saving of road space** which results from the use of the carrier-limber for road transport is obvious.

TRAILERS

The Carden-Loyd Gun Carrier-Limber

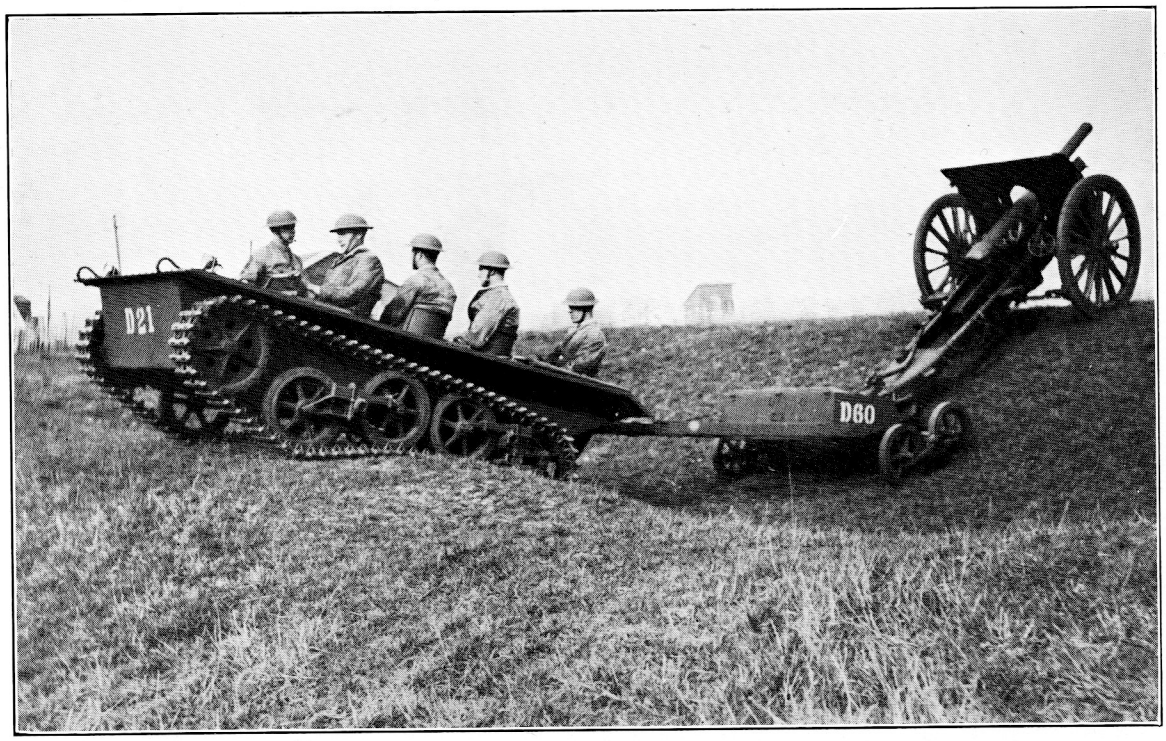

Plate XXX

When it is desired to tow the gun across country, the carrier is used as an ordinary gun limber, as shown in Plate **XXX**.

The change from one position to the other can be carried out by four men in a very short space of time—a minute or two only. When in this position the gun is attached to the carrier-limber by means of a special towing hook.

Details of Gun Carrier-Limber for 75 mm. Field Gun.

Weight (unladen) . .	13 cwt. 1 qr. (673 kgs).
Length	14 ft. (4.27 ms.)
Width	7 ft. 5½ ins (2.27 ms.)
Height	2 ft. 6¼ ins. (76.7 cms.)

SECTION VII

THE
VICKERS-ARMSTRONGS-STRAUSSLER
FOLDING-BOAT
PONTOON EQUIPMENT

THE VICKERS-ARMSTRONGS-STRAUSSLER FOLDING-BOAT PONTOON EQUIPMENT

Plate XXXI

The Pontoon in the Folded Position.

One of the most serious obstacles to the movement of tanks, or other natures of tracked vehicles, is deep water. It is certain that as the employment of such vehicles develops in modern armies, the use of rivers and canals to hamper, or prevent their movement will also increase.

To force the passage of a river in the face of the enemy is a difficult tactical operation, which demands both secrecy and rapidity. If the operation has to take place at night, its difficulties are greatly increased.

It is obvious, therefore, that the problem presented by the inability of tanks and tracked vehicles to cross deep water urgently demands a solution.

The Vickers-Armstrongs-Straussler pontoon equipment provides a practical solution of this problem. The equipment referred to **represents a revolutionary departure in the method of building up bridge units.**

PONTOON EQUIPMENT

It consists, briefly, of a number of collapsible pontoons, which, for transport purposes, are packed flat in the folded-up position, and when opened out carry a standard superstructure to form the roadway of the bridge.

Plate XXXII

The Pontoon Open.

The operation of opening the pontoons from their folded position is very simple, and occupies only a few seconds of time.

Compared to the pontoon equipment in general use in the armies of the world to-day, the solution of the bridging problem provided by this equipment is so obviously superior that it is only necessary for it to be seen for its immense value to be appreciated.

BUILDING A BRIDGE.

Each bridge section is built up of two (or three) of these pontoons, the roadway being fixed across them and consisting of four superstructure panels 22ft. (6.7ms.) in length, and consists of only 6 (or 7) pieces, i.e., the two (or three) pontoons, together with their four strips of superstructure. Each bridge unit of

this nature is complete in every particular and can be joined up to successive units in the shortest possible time—a matter of seconds only.

Plate XXXIII shows the Carden-Loyd Light Tractor traversing a stream 28 yards (25.6 metres) wide, across which a bridge of two sections of pontoons has been built. In this case each section consists of three pontoons and the roadway.

The number of pontoons which are used to build up each section depends upon the rolling load which the bridge has to carry. Two pontoons are sufficient for a $4\frac{1}{2}$ tons rolling load, while for a 6 to $7\frac{1}{2}$ tons rolling load, three pontoons are required. The four strips of superstructure are the same in both cases.

All the necessary fittings for both pontoon and superstructure are rigidly attached to them and there are no separate parts, so that there is no risk of any such being lost in the confusion of a river crossing at night or in the presence of the enemy.

The pontoons themselves, which when folded up are 22 ft. (6.7 ms.) in length, 5 ft. 8 ins. (1.7 ms.) in width and $7\frac{1}{2}$ ins. (19 cm.) thick, form opened out a boat with a beam 6 ft. (1.83 ms.) in width and with a depth of 2 ft. 3 ins. (68 cm.). They are constructed of 5-ply mahogany with Rock Elm gunwales and spruce strakes, while all the metal fittings, such as those for the automatic toggle gear for opening and closing the pontoons, are made of steel and phosphor bronze or non-corrosive silicon aluminium.

The normal displacement of each pontoon of this nature is approximately 4 tons (4,064 kgs.), while the weight of each pontoon is approximately 700 lbs. (317.5 kgs).

Vickers-Armstrongs-Straussler pontoons (and bridges) are built in all sizes and are of several different types. They can be used to build anything from a light infantry bridge, to bridges capable of carrying the heaviest tanks, or artillery.

It will be seen from the illustration (Plate XXXIII) that the two outside sections of the roadway are secured to the pontoons by means of metal clamps.

The superstructure, which is made in 22 ft. (6.7 ms.) lengths and in four separate panels, forms a roadway 9 ft. 6 ins. (2.9 ms.) wide. The panels, which are made of pressed steel channels with cross beams of spruce are normally 2 ft. $4\frac{1}{2}$ ins. (72.4 cm.) wide, four of these giving the 9 ft. 6 ins. (2.9 ms.) roadway referred to above. *They can, however, be made wider if required.*

The total weight of a complete section of superstructure (roadway) of this nature, i.e., 22 ft. (6.7 ms.) in length by 9 ft. 6 ins. (2.9 ms.) wide, is 1,700 lbs. (773 kgs.).

PONTOON EQUIPMENT

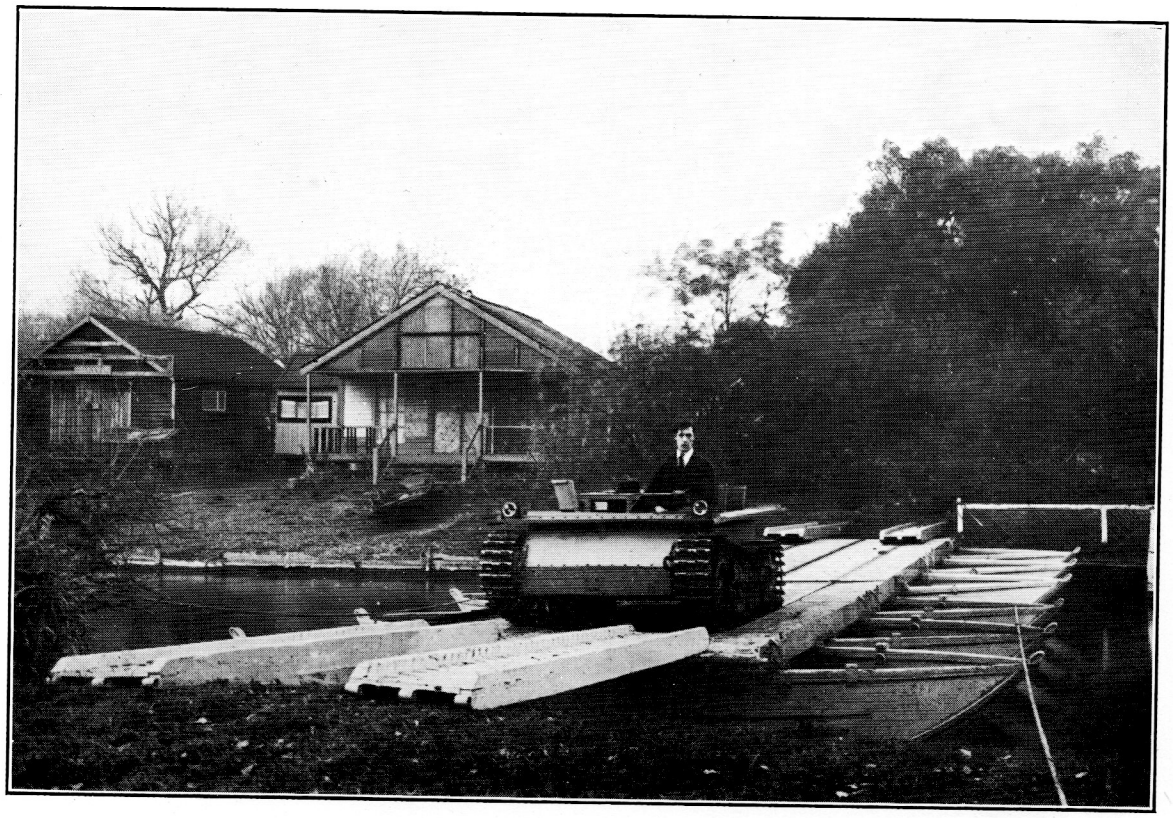

Plate XXXIII

Carden-Loyd Light Tractor crossing a stream 28 yards (25.6 metres) wide.

The details of this superstructure can be clearly seen in Plate XXXIV which shows the Carden Loyd Light Tractor, together with two shore ramps, in process of being rafted across a stream.

To form a bridge the pontoons are positioned with their centre lines at a distance of about 13 ft. (3.9 ms) apart and the superstructure is then laid on top of the pontoons and coupled to them. If it is intended to use 3 pontoons for the bridge unit, the third pontoon is positioned between the other two.

STABILITY.

In order that the bridge may remain perfectly stable as the weight comes upon it, the forward ends of the shore ramps, shown in the illustration, must rest exactly between the first pair of pontoons. Similar arrangements must of course be made at both ends. An alternative method may be used, in which the outer ends of the shore ramps are supported by a pontoon, thus forming a pier to which the bridge sections may be joined, On a gently sloping shore, when this method is employed, the strips of superstructure may be used as shore ramps.

PONTOON EQUIPMENT

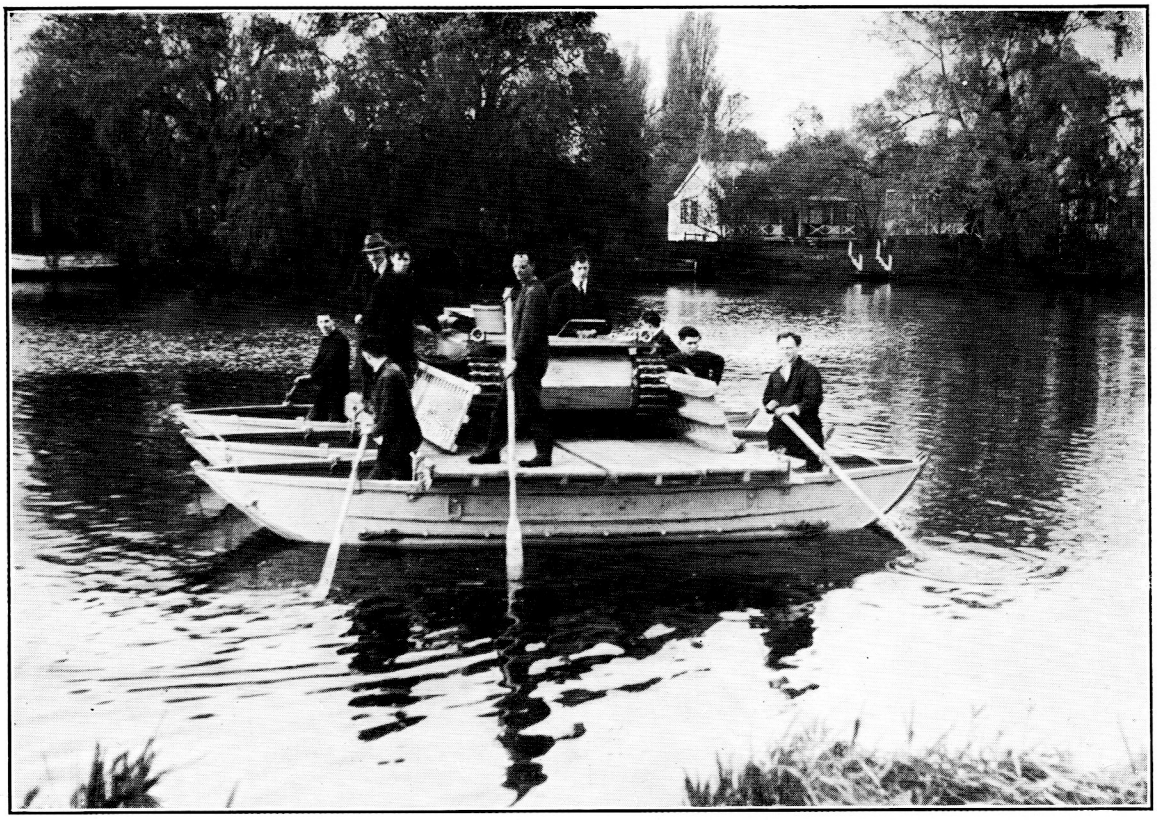

Plate XXXIV

Carden-Loyd Light Tractor being rafted across a stream.

With a complete bridge train, a section of special trussed girders is carried to provide means of getting on to and off the bridge. These trussed girders are carried upon a separate trailer.

The laying on of the roadway is a very simple process as the position of the superstructure is automatically determined by stops on the gunwales of the pontoons. It is obvious that this arrangement greatly facilitates building up a a bridge **in the dark or under fire,** as there is no loose tackle or timber of any kind. The coupling up of successive bridge sections can also be accomplished in a very short space of time, and under equally favourable conditions, the coupling up being performed by means of a special chain which is rigidly attached to the roadway.

The weight of the bridge section, consisting of two pontoons and superstructure, is about 3,200 lbs. (1,451.2 kgs.), while that of the three-pontoon section, complete with superstructure is 4,000 lbs. (1,814 kgs.). When packed flat the two-pontoon section makes a load of 22 ft. (6.7 ms.) maximum length,

PONTOON EQUIPMENT

5 ft. 8 ins. (1.7 ms.) maximum width and 2 ft. 6 ins. (76 cm.) deep. The three-pontoon section is 3 ft. 2 ins. (96 cm.) deep.

Provision can be made for building up a bridge of any length, capable of carrying artillery, tanks, tractors, lorries, etc., of a rolling load of anything up to 6 tons (6,096 kgs.) under normal conditions, or under favourable conditions, of a load up to $7\frac{1}{2}$ tons (7,620 kgs.).

It is possible to ferry gross loads of 12 tons (12,192.6 kgs.), using three pontoons for the construction of the raft.

TO ESTABLISH A BRIDGE HEAD.

As **surprise** is one of the principal factors in operations involving the bridging of a water obstacle, it is necessary that the enemy should be kept in ignorance of the proposed points of crossing.

It will often be necessary for small **covering parties of infantry** to be sent across the stream before the construction of the bridge is commenced, in order that the latter operation shall not come under the close rifle fire of the enemy.

The Vickers-Armstrongs-Straussler Folding-Boats are of a very particular value for this purpose. One boat, which can easily be carried by 10 men, opened up and launched without difficulty even in the dark, will carry 24 fully armed soldiers, in addition to the four men to row it.

Fitted with a 5 h.p. outboard motor, the boat can go upstream against the swiftest current. Against a current of average speed, the boat with this motor is capable of towing a string of loaded pontoons.

Should it be desired, for tactical reasons, to send small parties of men rapidly across a stream, there is another form of Straussler folding-boat, to which an outboard motor can be attached, which would be extremely valuable for this purpose.

Details of this boat and proposals for a suitable engine will be provided on application.

The opinion of a Senior Officer of the British War Office as to the value of the Pontoons, and of the other forms of Folding-Boat Equipment, will be found on Page 70.

PONTOON EQUIPMENT

TRANSPORT

Plate XXXV

A Carden-Loyd Light Tractor hauling two Carden-Loyd Trailers, with two complete Bridge Sections.

For transport purposes, a bridge train can be supplied consisting of the Carden-Loyd Light Tractor (weight 2.5 tons) and two double bogie self-tracking trailers, as shewn in Plate XXXV. Light overall chains can be supplied for fitting to the trailer wheels when the ground surface is very soft.

This material is sufficient to bridge a gap 28 yards (25.6 ms.) wide.

Each of the trailers carries three folding pontoons and four strips of the roadway superstructure previously referred to. The weight of each double bogie trailer is 0.75 tons (762 kgs.) and the dimensions and weights of the bridge train will thus be: -

Total length of Train, including Light Tractor and the two double bogie Self-tracking Trailers	59 ft.	18 ms.
Maximum height of the Pontoons when packed flat on the Trailers	6 ft. 6 ins.	1.98 ms.
Maximum width	6 ft.	1.83 ms.
Weight of Tractor	2.5 tons	2,540 kgs.
Weight of each double Bogie Trailer	0.75 tons	762 kgs.
Total for two double Bogie Trailers	1.5 tons	1,524 kgs.
Weight of each Pontoon	700 lbs.	317.5 kgs.
Total for Six Pontoons	1.88 tons	1,905 kgs.
Weight of each Roadway Strip	450 lbs.	204 kgs.
Total for Eight Strips	1.8 tons	1,830.6 kgs.
The total weight to be drawn by the Tractor	**5.18 tons**	**5,029 kgs.**

PONTOON EQUIPMENT

Summary of a few of the Advantages to be Gained by the Employment of the Vickers-Armstrongs-Straussler Folding-Boat Pontoon Equipment.

1. The folding boat is light and can easily be handled by ten men.

This is of particular importance when the bank of the stream to be crossed is marshy and difficult to traverse.

2. When being carried, the folding-boat, in its folded up position, is not top heavy, as is the ordinary rigid pontoon.

3. Owing to the development of air observation, the best form of cover to which all troops must have recourse in war, is afforded by a wood or forest.

It is certain, therefore, that the places selected for river crossing will often be those which are protected from view by dense trees. To carry an ordinary rigid pontoon through trees is impossible, unless a passage in the trees is cut.

With the **Vickers-Armstrongs-Straussler pontoon,** on the other hand, the boat, folded flat, can easily be carried by ten men through the densest wood.

4. **The saving of road space** is very considerable. The total length of the bridging train, including the light tractor and the two trailers conveying two complete bridge sections, is only 59 ft. (18 metres). Compared to the road space occupied by a pontoon train of the ordinary description, capable of bridging a similar gap, the saving in road space is enormous.

5. Similar considerations apply as to the space occupied by the pontoons in storage. If we compare the cubic space necessary for storing numbers of rigid pontoons with that occupied by the Vickers-Armstrongs-Straussler boats, when folded up, the advantage in favour of the latter is obvious.

PONTOON EQUIPMENT

The Opinion of a Senior British Officer, who is an Authority on Bridging.

Extracts from a Lecture given at the Royal United Service Institution, London, on 20th November, 1929, by Colonel A. Brough, C.M.G., C.B.E., D.S.O., and reproduced in the Journal of the Institution for February, 1930.

" . . . . There is now undergoing trial a type of Folding-Boat Bridge Equipment, which is lighter than our pontoon equipment, also less conspicuous, more easily, handled and considerably cheaper. The object of this type is to provide a means whereby the weapons designed for the close support of infantry may be sent across a river at the same time as, or very closely behind, the assaulting infantry, so that a definite bridge head may be formed to cover the subsequent crossing. It is hopeless to expect the heavier types of bridge to be erected under direct rifle fire and machine gun fire.

This boat folds up very nearly flat ; when opened it is rowed, or propelled by an outboard motor, so that it can, if need be, ferry infantry across a river. Formed up in a raft, it will enable a vehicle ferry to be put into operation with rapidity. Lastly, with the help of a special type of roadway, a bridge for light loads can be formed.

A similar but much smaller boat for reconnaissance purposes is undergoing trial. This is designed also to tow a rope across a river and possibly to put down a smoke screen. . . . . "

The above refers to the Straussler Pontoon Equipment.

APPENDICES

Vickers-Armstrongs and Carden-Loyd vehicles are covered by patents in all the principal countries of the world.

BRITISH ARMY MANŒUVRES, 1929

Group of Carden-Loyds, resting

Plate XXXVI

APPENDIX A

EXTRACTS from Articles by the Military Correspondent of the "Daily Telegraph" CAPTAIN B. H. LIDDELL HART, *which have appeared in the newspapers in the course of the last three years.*

1928.
6th July.

Tactics of the Armoured Force.

" . . . Its flank was protected by **light tanks** (*i.e.* Carden-Loyds),* whose security was in turn guaranteed by alternately leap-frogging companies of machine guns, and further out still, armoured cars.* . . .

" . . . This demonstration . . . was designed to show the working of the force to those unfamiliar with it, and it succeeded admirably. . . . It is hard enough for the anti-tank gunner to destroy a target that already has the protection of armour and mobility, but this new ability of fighting vehicles to 'skirmish' aggravates his problem. . . ."

22nd August.

Views as to Future Organization.

" . . . A fighting part of a true Armoured Force should be composed of these **cheap, light tanks,** with a proportion of gun-tanks for extra fire support, and perhaps a sprinkling of six-wheeled armoured cars as long range 'feelers.' And now in the new Carden-Loyd* and the new medium tank* . . . we have arrived at machines which fulfil the requirements of our thought . . . ."

26th September.

Strategic Considerations.

" . . . A study of the swift moves in Napoleon's campaigns illuminates this aspect of his famous saying that 'in war the moral is to the physical as three to one.'

"Once this is realized, *Mechanization,* in the sense of motorization, is lifted out of the realm of controversy. For simple arithmetic shows that the quicker any sort of troops can be moved, or switched from point to point, the greater is their strategic effect. To move on their feet is the slowest way. In these days a marching infantryman is an absurd freak. . . .

* Manufactured by Vickers-Armstrongs Limited.

The Tropical Type Carden-Loyd, showing Arrangement for Sun Protection.

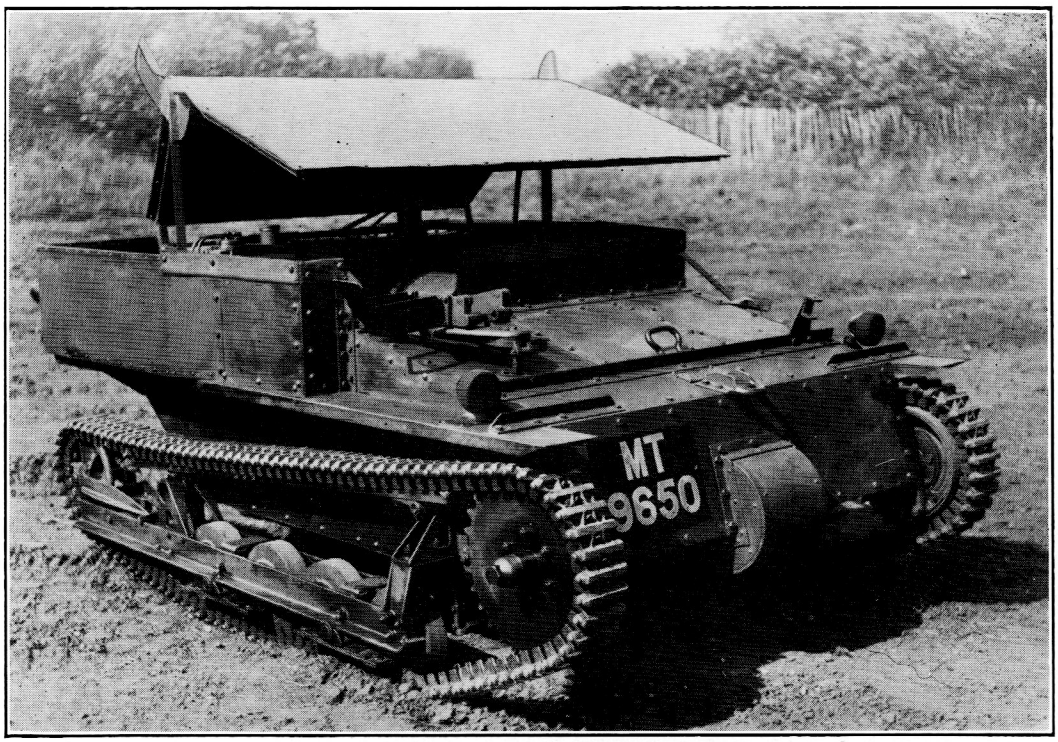

Plate XXXVII

" . . . Armoured forces, future armoured divisions, are as vital a requirement as cavalry divisions were in the past—before modern fire hamstrung them —to provide the Commander-in-Chief with a strategic thrusting weapon. . . . ."

1929.

15th April.

British Army Manœuvres, 1929.

" . . . On Tuesday, 10th September, preparation will begin for the mechanized manœuvres, surpassing anything in the past in quantity of tanks and smaller species of armoured fighting vehicles.*

"This will be a trial . . . of the new formations, created this year from the 250 light tanks* and armoured machine-gun carriers, of which the provision was first announced in the *Daily Telegraph* on 1st December. Deliveries are up to time-table, and by June the whole lot should be in the hands of their new crews."

31st August.

" . . . Unsupported by artillery, the Infantry were aided by a swinging punch of the light tanks from the south-east.

"Low built and fast, these used the folds in the grounds so well—and are so difficult to see, even within a few hundred yards—that I think they would have thwarted the hostile anti-tank guns. . . ."

17th September.

Use of Cover by Tanks,* and the Employment of Armoured Cars.*

" . . . The situation provided an instructive lesson in the ability of light tanks to reach a copse or other patch of cover unperceived, and there lie up to open a withering fire on unsuspecting bodies of the enemy—cavalry, infantry, or headquarters. . . .

" . . . The armoured cars of both sides were sent on long distance missions round the northern flank. Those of Westland went right round behind the enemy's rear and discovered the location and movements of his reserves. . . . ."

19th September.

Light Tanks and Mechanized Mortar Batteries.

" . . . The inclusion of light tanks has greatly increased the offensive power of the infantry brigade. In practice they have formed the real assaulting troops, and the infantry battalions merely a supplement for 'mopping up' and taking over captured ground. . . .

* Built by Vickers-Armstrongs Limited.

BRITISH ARMY MANŒUVRES, 1929

Carden-Loyd 3-inch Mortar Battery

Plate XXXVIII ["Army, Navy and Air Force Gazette," Photo.]

The Mortar in Action

" . . . The inclusion of mechanized mortar batteries seems an unqualified asset, as does the provision of mechanized machine-guns in the infantry battalion."

26th September.

Carden-Loyds.

" . . . This year has been the 'light tank year.' This summer enough **Carden-Loyds** were provided to form two battalions of light tanks, as well as serve as armoured carriers for some of the infantry machine-guns. . . . By their nimbleness, their invisibility, and their smallness as targets, they made a deep impression."

"A Swarm of Bees."

"Candid artillerymen said frankly that they could not hope to hit such tiny machines. Candid infantrymen confessed that they felt as helpless as if attacked by a swarm of bees.

"A few score of such midget machines was a very small number for effect, but it was enough to make officers picture the result of an attack by several hundreds—or thousands. And enough to make them realise that numbers are essential; that two hundred would be far more than ten times as effective as twenty. . . ."

30th September.

Saving Lives.

" . . . But however desirable are such armoured infantry, they are less essential and urgent, from a broad military point of view, than the provision of light tanks in true armoured formations. For the latter form the real strategic weapon which may nullify both the gaining and the holding of positions, and by manœuvre against the enemy's supplies, cripple him without a fight, thereby saving thousands of lives . . ."

BRITISH ARMY MANŒUVRES, 1929

Carden-Loyd with 95 mm. Howitzer crossing a
Vickers-Armstrongs-Straussler Folding-Boat Pontoon Bridge

Plate XXXIX

1930 THE BRITISH ARMY EXERCISES

EXTRACT from an article by CAPTAIN LIDDELL HART, *which appeared in the Journal of the Royal United Service Institution of November*, 1930.

Endurance of Mechanised Vehicles.

" . . . A number of points were brought out by actual experience. One was the increase of mechanical endurance. The Armoured Brigade made a 60 mile march, followed by a fighting advance of over 60 miles between 3 a.m. and the early afternoon of the following day. . . .

" . . . There has recently been a more striking example in **Egypt** where five Medium Tanks travelled 130 miles across the desert from Cairo to Alexandria, in thirty hours and eventually, after taking part in exercises, returned to their base through a sandstorm, **which stopped all other forms of transport.** . . .

Comparison of Carden-Loyds with Horsemen.

" . . . On most types of ground the visibility of a Carden-Loyd is much less than that of a man on a horse, and of several Carden-Loyds astonishingly less than several men on horseback. The Carden-Loyd merges more easily with the background and attracts the eye less in movement. . . .

Reconnaissance.

" . . . The value of information depends, first, on its exactness and, secondly, on the rapidity with which it is gained and sent back. Which is quicker — to travel nine and three quarter miles on a horse and a quarter of a mile on foot, or to travel nine and a half miles in a swift machine (Carden-Loyd) and half a mile on foot? The answer is unmistakable."

APPENDIX B

EXTRACT from an Article which appeared in the British "Royal Tank Corps Journal" for December, 1929, by Lieut. ROBERT ICKS, *of the U.S. Army.*

" . . . . There is no doubt that the . . . .* was in its day a very good fighting vehicle from many standpoints. It is small, fairly agile and cheap. On the other hand, it is slow and mechanically unreliable. . . . .

" . . . . **England**, with her modern equipment, is **far in advance** of all other nations **in tank development**. . . .

" . . . . Taking all in all, the . . .* tank has been a satisfactory weapon.

"However, I believe that so soon as the countries that have adopted the . . .* can afford to buy new material, they are going to turn to more modern designs, rather than try to get along with modified obsolete tanks of this type.

'What more suitable vehicle in practically every aspect is there than **the Carden-Loyd ? I look to see the firm of Vickers-Armstrongs, London, taking the first place in the development and production of the light tank. . . .**"

*A Foreign Competitor.

APPENDIX C

The Daily Telegraph

LONDON, TUESDAY, JANUARY 7, 1930.

SUPERIORITY OF OUR TANKS.

U.S. GENERAL'S TRIBUTE.

WASHINGTON, Monday.

A striking tribute to the supremacy of the British Army tanks was paid to-day by Major-General C. C. Williams, Chief of the Army Ordnance Department, in giving evidence before the sub-committee of the House of Representatives.

"We are nothing like so advanced in the matter of tanks as the British," he said. "They have been at it longer, have spent more money and made more progress than anybody else. No other country has developed tanks of such range and speed."—*Reuter.*

Vickers-Armstrongs and Carden-Loyd vehicles are covered by patents in all the principal countries of the world.

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